The FOUNDRY

Volume 48. No. 4
Whole No. 341

Published
Semimonthly

CLEVELAND, OHIO, FEBRUARY 15, 1920

Piston Rings Cast Centrifugally

Molds Are Made in Round Cast Iron Flasks With Layers of Cores—The Castings Are Entirely Surrounded With Sand—Centrifugal Pressure Produces Iron of Dense Structure

BY H. E. DILLER

CHANGES in composition and physical properties through manipulation in the melting furnace and subsequent heat treatment have given a great impetus to the metallurgy of steel. Different melting mediums such as the bessemer converter, the crucible furnace, the open-hearth and the electric furnace, have played important roles in the drama of better steel. However, the metallurgy of gray iron has lagged behind. The cupola still is by far the most commonly used melting medium for gray-iron, although for many years the air furnace has been employed to a limited extent, and recently the electric furnace has found favor in a few exceptional cases.

This notable difference in the development of melting mediums, heat treatment and metallurgy of the two principal ferrous products may be accounted for primarily by the influence of carbon in the two metals. The small portion of carbon in steel can be changed into pearlite or cementite and mixed in the steel with ferrite in various proportions to control the strength and ductility of the metal, while in gray iron a variation in the total carbon content does not make the marked difference in strength that it does in steel. This is due to the large amount of either graphite or of combined carbon which must be present in gray iron. If the total carbon is reduced too low in gray iron the advantage of ease in handling to a great extent is lost. On the other hand, if the total carbon is maintained around the normal amount found in cupola metal there is either 3.25 per cent graphite or that much combined carbon, or a mixture of the two in any proportion totaling about 3.25 per cent. This precludes heat treatment of gray iron with the exception of annealing. The heat treatment of quenching and drawing so frequently applied to steel, is impossible with gray iron on account of the high carbon content.

FIG. 1—METAL IS POURED INTO THE CENTER OF THE MOLD WHICH IS THEN REVOLVED AT A RATE WHICH PRODUCES A CENTRIFUGAL PRESSURE OF APPROXIMATELY 100 POUNDS PER SQUARE INCH

However, advancement recently has been made in the metallurgical treatment of gray iron brought about through experiment and a study of the properties of the metal and its action under different conditions. Experiments made by the Wasson Piston Ring Co., Plainfield, N. J., under direction of John A. Rathbone, foundry manager, have developed some important facts in the metallurgy of gray iron and also evolved a method of casting piston rings by the centrifugal process. Mr. Rathbone now

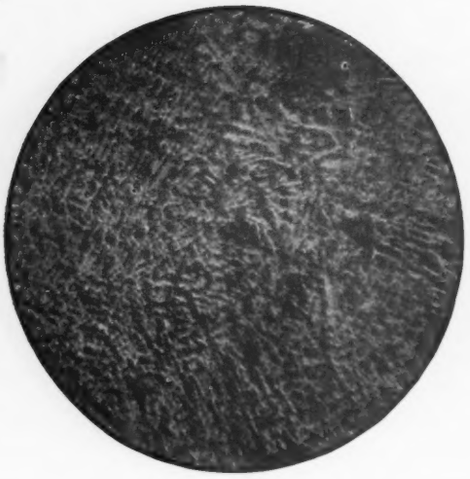
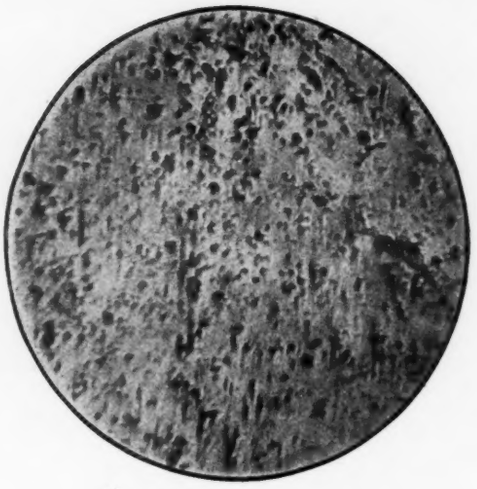


FIG. 2—AT THE LEFT —MICROGRAPH OF CHILL CAST METAL SHOWING THAT MOST OF THE CARBON IS COMBINED, BUT THERE ARE OCCASIONAL SPOTS OF FREE CARBON AS ILLUSTRATED IN THE UPPER RIGHT-HAND CORNER

FIG. 3—AT THE RIGHT —AFTER THE CHILLED IRON WAS HEATED FOR A MINUTE OR TWO AT NEAR 2000 DEGREES FAHR. A LARGE PORTION OF THE COMBINED CARBON SEPARATED OUT AS TEMPER CARBON —THE UNETCHED MICROGRAPH RESEMBLES A MICROGRAPH OF MALLEABLE IRON



is with the H. M. Lane Co., Detroit.

Formerly, the common method of casting piston rings, especially the smaller sizes, was from a long, cylindrical pattern. This gives a casting, called a pot, from which a number of rings are cut in the machine shop. As may be seen this operation involves considerable expense, and in some shops it has been superseded by the method of casting each ring separately. The latter process involves a considerable increase in the expense of molding due to the proportionately large amount of sand and of gates and risers to the amount of metal in the casting. To lower the molding cost the Wasson company decided to cast the rings in gray iron molds, frequently known as permanent molds. By this method, metal in the smaller rings became chilled. Some of the larger rings were not chilled when cast in a permanent mold but enough of every lot was chilled, at least in spots, to make it essential that all rings be annealed before being machined. For this reason, it was decided to study the effect of annealing. Some of the rings which were white, having been chilled through, were annealed. Although malleable iron, which is also a white iron, requires a number of hours to be annealed, this metal with its higher silicon content was found to reprecipitate out a large portion of its carbon on being heated a few minutes and allowed to cool in the air. Not more than 10 minutes were required to cool the metal to a black heat when it could be quenched in water without deteriorating effects. While this treatment changed a large percentage of the carbon from the combined to the temper form and the metal became machinable, the annealed iron was not malleable and the hardness as determined by brinell test was 250 or a little less.

Noted Annealing Effects

The microstructure of the metal before and after annealing is shown in Figs. 2 and 3. In Fig. 2 the white areas are cementite and the small dark portions are pearlite. The dark spot which may be noticed in the upper left corner is free carbon, not in the flake form of graphite but rounded like temper carbon. Although the fracture of this iron shows white, there are a few of these spots of free carbon scattered through the metal. Analysis showed the following composition: Silicon, 2.40 per cent; sulphur, 0.104 per cent; phosphorus, 0.65 per cent; manganese, 0.35 per cent; total carbon, 2.91 per cent. Practically all of the carbon was in the combined state when the metal was cast. After annealing, the iron contains 2.86 per cent free carbon and 0.68 per cent combined carbon. The free carbon is in the form known as temper carbon, as may be seen from Fig. 3 which is an unetched micrograph. After annealing the sample has the appearance of malleable iron. The darker spots are the temper carbon. An etched sample shows that the background is mostly pearlite. Practically no ferrite is present and there is a far larger portion of pearlite than is found in malleable iron, owing to the higher percentage of combined carbon in the metal. This amounts to 0.70 per cent on the average. Some rings of annealed iron were tried out in a gasoline engine but did not prove successful because they lost their tension rapidly and wore excessively. It was concluded that the heavy wear was due to the rounded particles of temper carbon which did

FIG. 4—AT THE LEFT —POT RINGS CAST IN THE SAND HAD THE USUAL APPEARANCE OF GRAY IRON WHEN MAGNIFIED 150 DIAMETERS — AS MAY BE NOTED, THE GRAPHITE IS SEGREGATED IN LONG NARROW FLAKES

FIG. 5—AT THE RIGHT —CENTRIFUGALLY CAST METAL HAS A SOMEWHAT DIFFERENT APPEARANCE FROM THAT CAST IN THE REGULAR WAY— NOTE HOW MUCH MORE CONDENSED THE GRAPHITE FLAKES ARE THAN IN FIG. 4

not give as good lubrication as the graphite found in gray iron.

The results of the first annealing tests proved so interesting that further experiments were made to determine the effect of different annealing times and temperatures on the hardness of the metal. The results of these tests were as follows:

Time of annealing	Temperature Degrees	Brinell after annealing
1 min.	1850	250
1 min.	1850	250
3 min.	1950	241
5 min.	2000	238
45 sec.	1800	256
45 sec.	1800	250

The hardness of the different samples was so nearly equal after the foregoing anneals that it was decided to repeat the test, using greater variations in the time and temperature. This test gave the following results:

Time of annealing	Temperature Degrees	Brinell after annealing
30 sec.	1800	242
45 sec.	1850	250
1 min.	1900	242
1 min. 15 sec.	1950	235
1 min. 30 sec.	2000	235
2 min.	2100	242
3 min.	2200	260

Samples from each set of both lots were polished and examined under the microscope. All samples had approximately the same appearance as the micrograph, shown in Fig. 3, which has the carbon precipitated out in the rounded form instead of in the form of flakes.

Higher Carbon Effects

Tests then were made with iron higher in carbon and lower in silicon content. This iron was of the following composition:

Silicon	1.82
Sulphur	0.084
Phosphorus	0.68
Manganese	0.37
Total carbon	3.55

The following table giving the hardness numbers of samples of this iron annealed at different temperatures and for various durations of time shows that an increase of time or temperature or both does not decrease the hardness, but on the contrary the opposite seems to be true, as may be seen.

Time of annealing	Temperature Degrees	Brinell after annealing
5 min.	1900	273
4 min.	1850	273
3 min.	1850	273
2 min.	1800	256
1 min. 30 sec.	1700	259

These rings also were polished and etched and showed the same structure as the other annealed rings. The rounded form of the free carbon, having been shown by the practical tests in a gasoline motor to lack the lubricating qualities of the flaked graphite in the regular gray-iron castings, it was decided to endeavor to bring this temper carbon to the graphitic form. This was sought by redissolving it and again precipitating it out. As some of the rings already annealed had been heated to a mushy state it was determined that even a higher temperature would be necessary to redissolve the temper carbon. Pieces of rings were placed in a silica crucible and heated until the metal settled to the bottom of the crucible in the form of a button. The crucible then was taken from the furnace and allowed to cool in the air. A microscopic examination of the metal showed the carbon to be still in the rounded form of temper carbon. A second lot was melted and held in the melted state for 1½ minutes before being allowed to cool in the air. Upon examination, no graphitic carbon was found in this sample. A third sample was melted and kept in the furnace for three minutes. After being cooled in the air this sample contained a portion of its carbon in the graphitic form as was shown by the miscroscope.

Chill May be Eliminated

From the tests made by the Wasson company it developed that chilled iron which is hard and contains almost all of its carbon in the combined state can be made fit for machining by annealing. However, the carbon separates out as temper carbon and does not give the iron the lubrication which is obtained when the carbon is in the graphitic form. This makes such metal unfit for use in piston rings. The carbon change begins above the critical temperature, about 1300 degrees Fahr. and continues up to 2000 degrees when the maximum amount of carbon is precipitated. The maximum has been found to be about 80 per cent of the total amount of carbon in the metal. Thus an iron with 3 per cent carbon, which would be practically all combined carbon in the chilled state, will contain approximately 2.40 per cent temper carbon and 0.60 per cent combined carbon after being annealed a few minutes at 2000 degrees Fahr. It also was shown that this temper carbon which separates out between 1300 and 2000 degrees Fahr. cannot be turned to the graphitic state until the iron is actually melted for a space of time. These experiments convinced the company of the impracticability of casting piston rings in permanent molds.

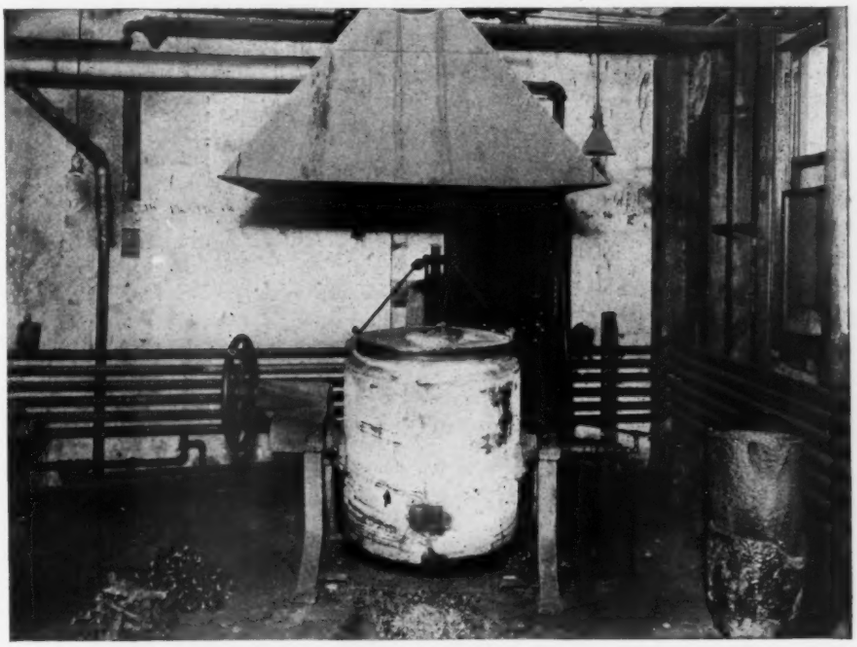


FIG. 6—THE METAL IS MELTED IN A TILTING CRUCIBLE FURNACE AFTER HAVING BEEN BROKEN FINE—CHARCOAL IS ADDED TO THE LADLE TO PREVENT LOSS OF CARBON IN THE METAL BY OXIDATION

One other method of casting piston rings seemed to offer encouragement. This was some form of centrifugal process. A small section of the shop was equipped to conduct experiments with this method. The results obtained were so satisfactory that the company decided to extend its operations along this line.

The experimental department uses two crucible melting furnaces of the tilting type, furnished by the Monarch Engineering Co., Baltimore. These furnaces are heated by oil. The one is fitted with a crucible which will contain 180 pounds of metal in a heat, while the other is somewhat larger, accommo-

dating a crucible which will hold 450 pounds of iron. Experience has shown that crucibles will last slightly more than 10 heats, on an average. Scrap piston rings and gates and risers are the only stock used. This insures uniform metal from one day to the other and is highly important because the peening machines which hammer the piston ring and cause it to take its shape are set for a certain kind of metal. If the metal should vary from day to day the machines would form rings which would not be truly round and it would be necessary to readjust them frequently.

All of the scrap is broken into fine pieces before being charged. In this condition it will melt quicker and more can be placed in the crucible in the primary charge. Some of the broken scrap may be seen in the foreground to the left in Fig. 6, which shows one of the furnaces and two of the crucibles which are used in it. The cover of the furnace which has a circular hole fits down around the upper edge of the crucible which is closed with a loose-fitting cap. This arrangement prevents the flame from striking the metal in the crucible. The crucible is filled as full as possible with metal at the start and some charcoal is added. After the metal settles in the crucible on melting, more metal and, if necessary, more charcoal is added. At the end of the heat charcoal is floating on top of the melted metal. In this way the iron is kept thoroughly deoxidized and saturated with carbon. This practice brings the total carbon in the metal to about 3.50 per cent. The other metalloids in the iron are: Silicon, 1.90-2 per cent; sulphur, 0.1 per cent; phosphorus, 0.8 per cent; and manganese, 0.5 per cent. The carbon is divided into approximately 0.75

FIG. 7—FOUR RINGS ARE CAST IN THE SAME MOLD—NOTE THE VERTICAL RUNNERS WHICH ACT AS FEEDERS

per cent combined carbon and 2.75 per cent graphitic carbon, but varies slightly according to the section of the ring into which it is cast. One of the important points in the process has been found to be the temperature of the metal when poured. It was learned from experience that metal poured below 2600 degrees Fahr. will form an imperfect ring. To test the temperature of the iron a No. 15 seger cone which melts at 2606 degrees Fahr. is placed on the bath and the metal is not poured until the cone is melted. Daily experience has taught the melter to gage this temperature accurately and the cone now is used in the ladle only once a week.

Piston rings from 8 to 29 inches in diameter have been made on the centrifugal machines. Two of these are installed. Rings up to 17 inches in diameter are cast in the smaller machine and the larger rings are cast in the other machine. The smaller machine with a mold ready to cast, is shown in Fig. 1. Molds are carried to the centrifugal machine by a chain hoist operating on an I-beam as shown to the right. For different sized rings different speeds of revolution are required as it is endeavored to revolve the flask at a speed which will produce a centrifugal pressure equal to 100 pounds per square inch. This requires on an average a speed of 300 revolutions per minute.

To obtain the different variations from this speed a friction cone drive shown in the upper portion of Fig. 1 is employed. The variation of speed is secured by moving a leather belt along the cone. This belt extends around the rear, or driving cone. As this belt is moved toward the small end of the driving cone this cone must make more revolutions to turn the driven cone one revolution and thus the speed may be varied. The cones are moved together to start the machine and the belt around the driving cone is thus pressed against the loose cone which it drives by friction. Five sizes of cast iron flasks are employed. In the smallest one, rings are made from 8 to 12 inches in diameter; the second size is used for rings from 12 to 15 inches in diameter; the third for rings

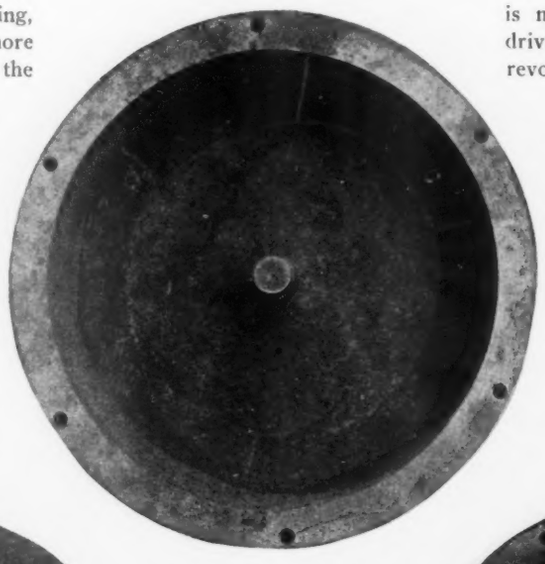


FIG. 8—ABOVE—A LAYER OF FLAT CIRCULAR CORES IS LAID AROUND THE BOTTOM EDGE OF THE FLASK AND THE CENTER COVERED WITH LOAM

FIG. 9—AT THE LEFT—CORES ARE LAID UP IN TIERS—TWO HOLES FOR THE RUNNERS ARE PROVIDED IN EACH SECTION OF CORE

FIG. 10—AT THE RIGHT——THE CORES ARE NOT PASTED BUT AFTER THEY ALL ARE ASSEMBLED A CAST-IRON RING IS BOLTED TO THE FLASK TO HOLD THEM IN PLACE

from 15½ to 17½ inches in diameter; the fourth for rings from 18 to 22 inches in diameter, and rings from the largest size flask range from 22 to 29 inches in diameter. An empty flask is shown in Fig. 12. To make the mold the inside of the flask is lined with cores which are held down by a circular cast-iron ring as illustrated at *A* in Fig. 1. This ring is attached by bolts through the holes in the flanged rim, which may be seen in Fig. 8. The cores are made in sections, five or six sections of a core being required to make a complete circle, depending upon the size of the ring to be cast. Six circular layers of cores form a complete mold for four rings. The cores are made of sharp sand with an oil binder. A rollover core machine built by Henry E. Pridmore, Chicago, is used. At present three cores are made at once in a wooden corebox but later metal boxes will be provided and five cores will be turned out at a time.

In building up the mold a circle is first made with cores like the one shown at A, Fig. 11. This core is ½-inch thick and from 3 to 3½ inches wide, according to the size of the ring to be made. The length is such that five or six cores will complete the circle, as has already been mentioned. This circle of cores serves as a guide for putting in the sand bottom. The bottom is made after the flask has been rubbed with core oil. The sand used is a mixture of sharp sand with fireclay, dampened to make it cohesive but not sticky. It is tucked in by hand and scraped flat, level with the core, after which it is slicked with a trowel and the excess is thrown out. A mold at this stage is shown in Fig. 8. The cores around the edge at the bottom of the flask are slightly darker than the loam towards the center. The pin indicated by the light circular area in the center is a part of the flask. It covers the hole in the bottom which is provided for screwing the flask to a center pin in the base plate of the centrifugal machine.

After the loam has been molded in the flask, the bottom is washed with graphite, and then skin dried with a gas flame. Later the flask is set on bricks and a gas flame is placed underneath it until the entire mold becomes thoroughly dried. This is only a temporary arrangement, which will be displaced later by oven drying. A continuous oven will be built through which the molds will be carried on an endless chain.

When the mold is dried a row of cores similar to the one shown at *B*, in Fig. 11, is laid around the edge of the flask with the face which is shown in the illustration turned down. The groove in this core layer forms a piston ring. Above this three more successive layers are laid using cores similar to the one shown at *D*, Fig. 11. Like the first layer these three layers are placed with the groove down. Once a week a layer of cores like the one shown at *C* is substituted for one of the layers of cores, *D*. As may be seen from the illustration the core, *C*, forms a long rectangular piece. As there are six of these cores in a circle, six of the rectangular pieces will be cast. These are used as test bars.

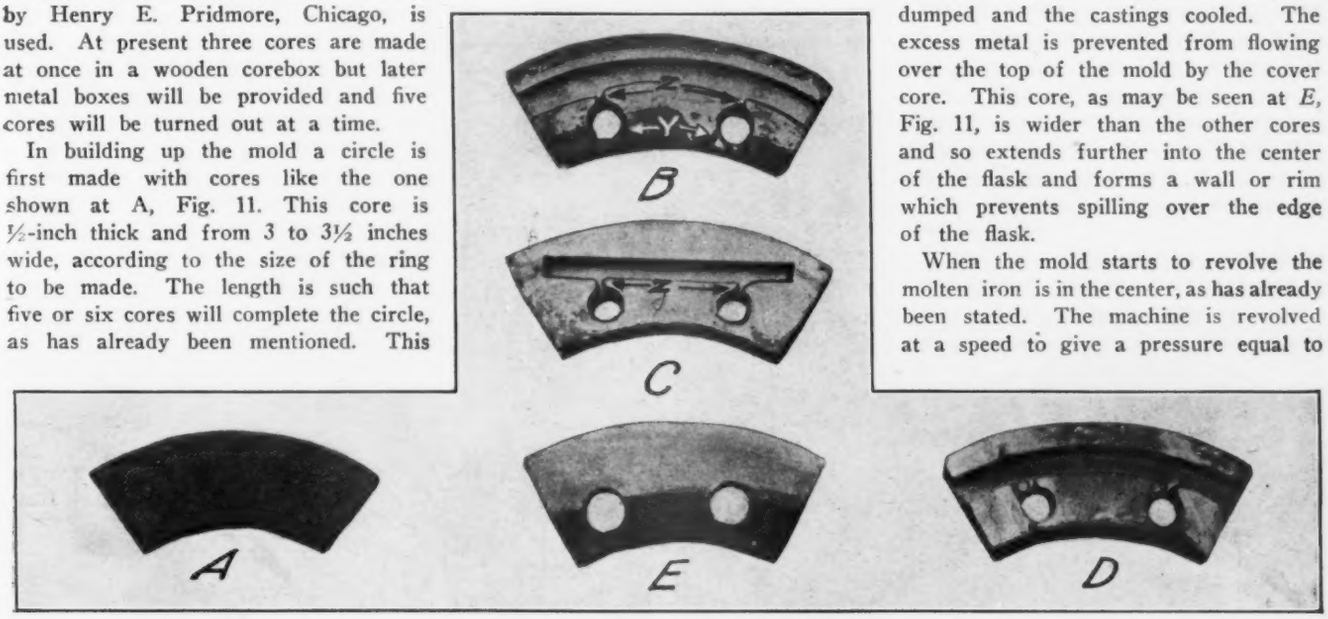


FIG. 11—RINGS OF CORES ARE SET IN LAYERS TO FORM THE CASTINGS—THE METAL GOES THROUGH THE GATES AT *Y* INTO THE RUNNERS FORMED BY THE HOLES IN THE CORES—FROM THE RUNNERS THE METAL GOES TO THE CASTINGS THROUGH THE GATES, *Z*, WHICH ARE IN EVERY CORE EXCEPT *A*

A core as illustrated at *E*, Fig. 11, is laid on to of the four layers of cores which form four piston rings, or three rings and six test bars if the test-bar cores have been used. On top of the core *E*, a layer of cores, *A*, is laid to act as the cover core. No paste is employed but the cores are held down by a cast-iron ring bolted to the top of the flask. A mold partly made is illustrated in Fig. 9, while one ready for the cast-iron cover ring is shown in Fig. 10.

The flask is screwed to the center pin of the centrifugal machine for casting. Metal is poured into the center of the flask after which the machine is started and the mold is revolved. The amount of iron to be placed in each mold is gaged close enough for practical operation by the quantity in a hand ladle used for pouring. Should the iron poured into the flask fail to fill the mold, the risers are not rounded out, as may be seen at *A*, Fig. 11. However, this does not affect the casting unless the amount of metal is so scant in the runners that it does not feed the castings properly. On the other hand, should too much be added to the flask, the metal does not all enter the mold but the excess stays around the inner edge of the mold and easily can be broken off when the mold is dumped and the castings cooled. The excess metal is prevented from flowing over the top of the mold by the cover core. This core, as may be seen at *E*, Fig. 11, is wider than the other cores and so extends further into the center of the flask and forms a wall or rim which prevents spilling over the edge of the flask.

When the mold starts to revolve the molten iron is in the center, as has already been stated. The machine is revolved at a speed to give a pressure equal to 100 pounds per square inch. The metal thus is forced into the mold through the only gates provided, which are in the lower tier of cores. These gates may be seen at *Y*, Fig. 11. It may also be noted that similar gates are not provided in the other cores as indicated in *D*, Fig. 11. Flowing through these gates the metal rises in the runners formed by the holes in the cores and through the gates *U*, in cores *B*, *C* and *D*, Fig. 11, to form the castings.

The mold is spun for about 1½ minutes by which time the metal has set. The flask is then removed from the machine and another put on. The mold usually is dumped at once and the flask returned to the molding floor, after first having been cooled with water. In this way only enough flasks are needed to take care of one charge of iron in each of the two furnaces. New molds are made each time while metal is melt-

ing in the furnace. Before the mold is dumped the circular cast-iron cover is unbolted and removed and a large proportion of the cores which have not been broken are recovered for use a second time.

A simple way of making a mold when it is inexpedient to make a core box is illustrated in Fig. 12. In this case only a few rings of a special size were desired. Instead of making a core box to produce cores for casting the rings separately, a lining of sand with a groove in it was swept with the crudely made sweep shown in the illustration. Although this sweep is constructed in the most simple manner, it performs its function credibly. When the mold was made a top core was placed and a cast-iron plate was bolted to the top of the flask. The mold then was ready for casting. Extra machine work was required to cut the rings from this pot casting, and to turn off the extra metal which it was necessary to cast in the inside of the ring, in order to compensate for any variation in the amount of metal poured into the flask.

By the centrifugal method of molding as now practiced the casting is entirely surrounded by sand which prevents irregular cooling and chilling. A mold made of cores which did not entirely surround the castings was tried in the earlier experiments. It was made as illustrated by the section of cores shown in Fig. 13. This also shows the appearance of the finished castings, bound together by the cylinder formed by the surplus metal necessary to insure a sound casting. When molds first were made with the cores entirely surrounding the metal in the castings, difficulty was encountered due to shrinkage near the gates. This was overcome by increasing the size of the runners which now act as feed heads.

Briefly, the Wasson company finds in this process that the molds made in dry sand produce better rings, with all the benefits of dry-sand casting. The metal is cast under pressure and has a closer grain with greater strength. The loss due to dirty metal or other causes is small, as is also the percentage of metal in gates and riser. Much less sand is handled in making the mold.

The metal when cast in regular sand molds has a tensile strength from 20,000 to 25,000 pounds per square inch, while metal cast in the centrifugal machine will stand a pull of from 30,000 to 34,000 pounds per square inch. Tests are made on test bars cast as already described. These bars are 9 x ¾ x 1⅛ inches and are machined for testing to a section ½ x ¾-inch for a 2-inch length. The dense structure given to the metal by the pressure from the centrifugal force is illustrated by the micrograph, Fig. 5, which may be contrasted with Fig. 4. The latter is a micrograph from a ring cast in a sand mold. The graphite in the centrifugal-cast metal is shown to be in smaller particles and more evenly distributed than in the sand-cast metal.

The loss from defective castings in the centrifugal casting method will average 2 per cent which is much below the average loss obtained under the common method of casting piston rings. This loss may be accounted for partly by the fact that the heavier metal is thrown forcibly to the outside by the centrifugal pressure and any slag or other dirt which may be present is held back in the risers. The success of the centrifugal method of casting piston rings has led the Wasson company to contemplate the installation of an electric furnace for melting the metal, to provide greater melting capacity.

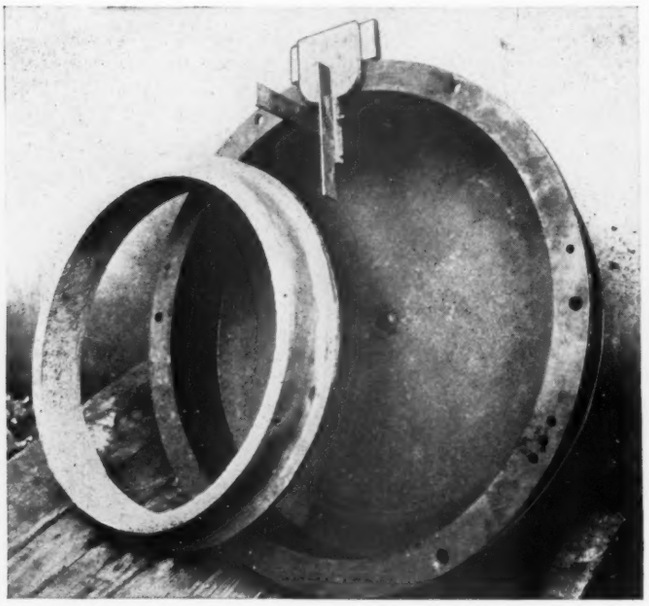


FIG. 12—A POT-RING CASTING WAS MADE BY SWEEPING UP A FORM IN A FLASK TO SAVE THE EXPENSE OF MAKING PATTERNS FIG. 13—ONE OF THE ORIGINAL WAYS OF CASTING RINGS WHICH DID NOT PROVE ADVANTAGEOUS

Handling Manufacturers to Hold Meeting

The Material Handling Manufacturers' association will hold an open convention at the Waldorf-Astoria hotel, New York, on Feb. 26-27. Manufacturers from any part of the United States will be welcome, especially companies manufacturing overhead, locomotive, gantry cranes, hoists, winches, portable, gravity and power conveyors, industrial trucks, tractors and trailers, bulk handling machinery, elevators and all forms of equipment and supplies used in the construction and operation of mechanical handling machinery.

Arrangements have been made to hold a morning business session on Friday, Feb. 26, which will be followed by a formal luncheon at the Waldorf-Astoria. The afternoon session will be devoted to papers and discussions on mechanical handling problems. A number of papers will be illustrated by moving pictures, showing views of some of the latest and largest installations.

Reservations for the luncheon may be procured from W. J. L. Banham, Otis Elevator Co., New York City; Chas. A. Rohr, General Electric Co., New York City; Richard Devens, Brown Hoisting Machinery Co., New York; or from the secretary and manager, Zenas W. Carter, 35 West Thirty-ninth street, New York.

Advantages of Uniformity in Costs

An Accurate Cost System Based on a Uniform Plan is Only Successful When it Serves With Equal Fidelity the Sales, Production and Financial Departments

BY C. E. KNOEPPEL

PERHAPS the greatest problem before American industry today is that of determining accurate cost of production. Industry is becoming so complex, tax laws are so intricate and the matter of accurate returns are so important that the concern operating without knowledge of costs, is in the worst possible position to conduct its business to the best advantage. Another and perhaps the most important reason why costs must be accurately ascertained, is to enable the manufacturer to determine just what he can do in the way of increasing wages and arranging for profit-sharing plans. He must know where he stands with reference to his production costs.

There are three factors which whether considered separately or in combination, can cause distress to an industrial concern. These are: Lack of systematic production methods, failure to ascertain accurate costs, and lack of uniformity in costing or in bidding on work.

Comparison Not a Solution

It is difficult to bring about agreements as to prices but a careful study of the situation leads to the conclusion that agreement as to price is not necessary. The comparing of bids is not altogether an essential. Combination to control a local situation is not the solution. There should be such uniformity in ascertaining and compiling costs and making estimates as to insure against wide differences in prices. Every manufacturer who furnishes a product of good quality and who can make reasonable deliveries is entitled to his share of the available business at a fair and reasonable margin of profit. Any concern which purchases a product below the cost of production is enjoying something to which it is not entitled and which really belongs to the manufacturers of the particular product.

If, after providing uniformity and accuracy in cost keeping, a concern finds that it is consistently higher in its bidding than others, it can only mean that it is not operating efficiently, or that it is adding too much profit to its costs. Knowing these things, the company is in a position to check up its weak spots and determine where the faults are and then correct them. Uniformity in costs means intelligent competition as well as furnishing a means for increasing operating results. Many manufacturers admit that they have no objection to the hardest kind of competition when they know that their competitors are operating intelligently along uniform lines and with full knowledge of the true conditions.

Recently a concern contracted to furnish castings at $2.85 per 100 pounds. When it became apparent that money was being lost somewhere, an investigation was made with the result that the actual cost of this particular work was found to be between $4 and $5 per 100 pounds. This naturally brings up another point. Not only does the buyer profit to the extent of the difference between the cost to the foundrymen and the price the buyer pays but he will expect some of the other foundrymen when the present contract expires, to furnish him castings for a price not much in excess of $3 per 100 pounds. If he cannot get a quotation near this figure he will advertise his requirements until some foundryman who must have the work at any figure, or who does not know his exact costs, will give him a bid that is satisfactory, and as a result the honest, intelligent foundryman is placed at a decided disadvantage. But was not some foundryman to blame in the first place?

Crowding Bidders

A manufacturer wires that he is in the market for castings, offers prints and specifications and the foundryman makes him a bid on the work. Later the manufacturer tells the foundryman that his price is too high and that as long as he cannot give a better price the manufacturer will be forced to place his contract elsewhere. The manufacturer no doubt advanced the same argument to all who bid on the work. It is often done. He is secure in his belief ,that each one is in ignorance of the prices quoted by the others and as a general rule he is in a position tc say that he has an even better price than the lowest quoted. The result is that the contractor not only bids against the others but worst of all he bids against himself.

Men go into business to make money and to do this there must be profits. There can be no profits unless costs are less than prices. Therefore costs should be known. The accounts should show what it costs to run a buiness. If costs are high the system should show where they are high and why they are high. An average cost means nothing at all except that some castings cost less and some cost more. A true cost system should show how much more and how much less.

Uniformity Essential

All agree to some extent that cost accounting is necessary, but there is something more important, however, than for each to have a good cost system. The basis for costs should be uniform so that all will figure along the same general lines. Even if 10 factories should put in cost systems, as complete as 10 different experts could make them, assuming that each one was different from the others, the net result to the individuals and to the industry would be worthless and time and money would be wasted.

It has been found by experience that unless four principles are incorporated in cost systems, they fall far short of performing their real functions. These principles are:

A cost system to be of the greatest possible value to a business must serve the three principal divisions of the business, namely sales, production and financing.

It is necessary to predetermine the time and cost of every job and to control production so as to watch fluctuations and exceptions with a view to reducing costs, while the work is being done.

From the standpoint of estimating and business getting, costs can only be used to advantage as a rule when the plant is operating at or about normal capacity. By normal is meant

---

Abstract of paper presented at the annual meeting of the American Foundrymen's association, Philadelphia. The author, C. E. Knoeppel is connected with C. E. Knoeppel & Co., New York.

from 80 to 90 per cent of the possible capacity of the plant. For this reason while providing for actual costs, standardization of cost rates, especially overhead rates, should be arranged for in order that estimates may be more uniform and the costs made of real value to the sales and production departments.

Cost finding should be arranged so as to make the most complicated work net the greatest returns in profit. As the time of workmen and equipment are the productive investment in a business, it stands to reason that a man should get more for a job taking $300 in labor than one costing $150 for labor, and the cost keeping and price making should reflect and reconcile these differences.

It is not sufficient to have a system which may be perfect from the financial standpoint, but which gives the production division of the business so little in the way of available cost data as to make it impossible for it to assist in reducing costs, nor is the cost data of assistance to the production division if the cost information is presented so long after the operation which the figures represent as to make it next to impossible for a man to remember what caused the fluctuations. Certainly there is no advantage to the sales manager if he can only rely on the cost figures when the plant is operating at normal capacity.

Financial or Engineering Costs

In a certain plant both the treasurer and the production manager wanted a cost system, but each one wanted a different kind of a system. The treasurer wanted a financial accounting system to show his directors where the money was spent, and why, making the shops fit with his plans instead of basing his work on manufacturing conditions. The production manager on the other hand, advanced the argument that he was employed, first, to get out production as rapidly as possible, next to keep the expense down to a minimum and finally to render a proper accounting for the time and cost put in on work. In other words, the one wanted financial costs, and the other engineering costs. The one wanted to be a historian delving into the past, while the other preferred to be a prophet looking into the future. One would make cost a prime consideration of the business and the other would make it a part of manufacturing. The production manager was right.

If a careful estimate is made prior to starting the work, it offers something to aim at and enables a constant check on results during the time work is being made. Knowledge of actual costs may serve to enable a man to do better next time, but predetermination will assist materially in keeping costs within certain limits. During the early part of 1908 the writer took charge of a large plant in Pennsylvania, comprising a structural shop, machine shop and foundry. The burden accounting employed at the time gave the machine shop more profits than it was entitled to, while the structural shop was showing profits less than those actually made. The foundry was selling castings to the machine and structural shops at actual cost, which did not include any proportion of the overhead expense of the company. In the changes that followed, each department was put on its own feet through the books of the company, with provision for monthly profit and loss statements. At the time the methods were introduced in the concern in question, the business was making very little money. Its sales were not large and it was a heavy borrower, with a pattern account far in excess of real value. It had a bond issue hanging over its head. Today this plant with two additions, is doing a capacity business, making excellent profits and declaring dividends. It is discounting its paper and has retired its bonds, while the pattern account is where it belongs.

The theory which the author had in mind was that the greatest volume of business could be secured only when the plant was operating at about normal. With high production meaning low cost, and low production high cost, under the usual method of accounting it meant that the sales and cost divisions came into conflict both when costs were high, which operated against obtaining business, and when costs were extremely low due to abnormal business, which resulted in quoting prices lower than would be necessary to secure the business.

Must Meet the Test

A concern is in business to sell. It may make what it can sell, or sell what it makes, but selling is the fundamental basis of any business, a point which many accountants and industrial engineers seem to forget. If, as a sales manager, I cannot sell goods because due to conditions being below normal my prices are too high, or because of an abnormally high production my prices are lower than I know I can get for my goods, I don't need to be an industrial engineer nor an accountant to know that something is radically wrong with the whole thing, both in theory and in practice.

With standard rates, however, reflecting normal conditions, I am assured against loss of business on the one hand and loss in prices on the other. I know also that on this basis the line which is profitable in the shop will show profits, whereas through operating on a low production basis the increased overhead will not only wipe out the profits, but make the line show a loss.

The most advanced doctrine of management is that the unit sold is really the time of equipment, the time of the workmen, the time money is tied up in materials, the time of clerical help, the time of storing materials in a given place, the time of making rigging, the time of transferring materials from one place to another, and the time of inspection. If there are delays or enforced idleness at any of these points the result will be high costs, which make for high prices.

Eight Points Urged

The eight requirements for foundry cost system are:

Cost of labor and material should be accurately determined and properly classified.

The expenses of a business or overhead or burden as it is called, should be carefully compiled and classified.

The apportionment of overhead to production must be arranged on some basis as will not make the cost of heavy work too high nor the cost of the light work too low, otherwise the result will be loss of sales on heavy work and plenty of light work at low prices.

Those who purchase castings should pay most for those which cost the most to produce, as reflected by the time taken to produce them.

Costs vary with productivity by which is meant the relative amount produced per man per day. The work of a man producing a ton per day costs less per 100 pounds than that of a man who produces only 500 pounds per day and the cost should reconcile this difference. In other words, consideration should be given to the fast and slow moving jobs.

Costs should be classified according to whatever plan will best meet the particular conditions. This can be done according to classes of work, kind of molding, separate patterns and classes of patterns, kind of cores, character of cleaning, according to departments, and by classified weights. Provision in all cases should be made for determining the cost of individual patterns.

Costs should be placed on a 30-day basis offering 12 opportunities per year for locating and correcting faulty conditions.

Costs should be based on standard rates for the various items in order

THE FOUNDRY DATA SHEET, FEBRUARY 15, 1920
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

DATA ON CHIMNEY DESIGN

By J. G. Mingle

CAPACITY OF CHIMNEYS

By the capacity of a chimney is meant the theoretical amount of fuel it will burn during a stated interval and consequently the theoretical amount of gases it will pass in the same time. The theoretical amount of fuel a chimney will burn is determined by the formula

$$W = W_o\sqrt{2gH\left(\frac{T_o}{T_c} - \left\{\frac{T_o}{T_c}\right\}^2\right)}$$

when W = weight in pounds of the gases passing any point in the chimney per second,
W_o = weight in pounds of a cubic foot of air at T_o,
g = acceleration due to gravity feet per second per second,
H = height of chimney in feet,
T_o = absolute temperature of outside air in degrees Fahr.,
T_c = absolute temperature of chimney gases in degrees Fahr.

With an outside air temperature of 60 degrees and an average chimney gas temperature of 600 degrees the above formula reduces to

$$W_h = 302\ D^2\sqrt{H}$$

whence $$D = \sqrt{\frac{W_h}{302\sqrt{H}}}$$

where D = diameter of chimney in feet,
W_h = weight of gases passing any point in the chimney per hour.

It is more convenient, however, to express the capacity of a chimney in terms of horsepower equivalent. Assuming that each pound of coal requires 24 pounds of air to burn it and that each boiler horsepower requires 5 pounds of coal per hour, the horsepower of a chimney equals

$$HP = \frac{385}{24 \times 5} A\sqrt{H}$$

whence $$D = \sqrt{\frac{HP}{2.52\sqrt{H}}}$$

where HP = rated horsepower of chimney.

Fig. 1 shows the diameter of a chimney required for the different horsepower with the heights as indicated.

The formulas and the accompanying curve hold approximately true for oil, coke and gas burning equipment.

Example: Find the diameter of a chimney 150 feet high with a horsepower equivalent of 1500.

Reading directly from the curve the diameter is given as 7 feet.

(Concluded on Data Sheet No. 322)

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

DATA ON CHIMNEY DESIGN

By J. G. Mingle

(Concluded from Data Sheet No. 321)

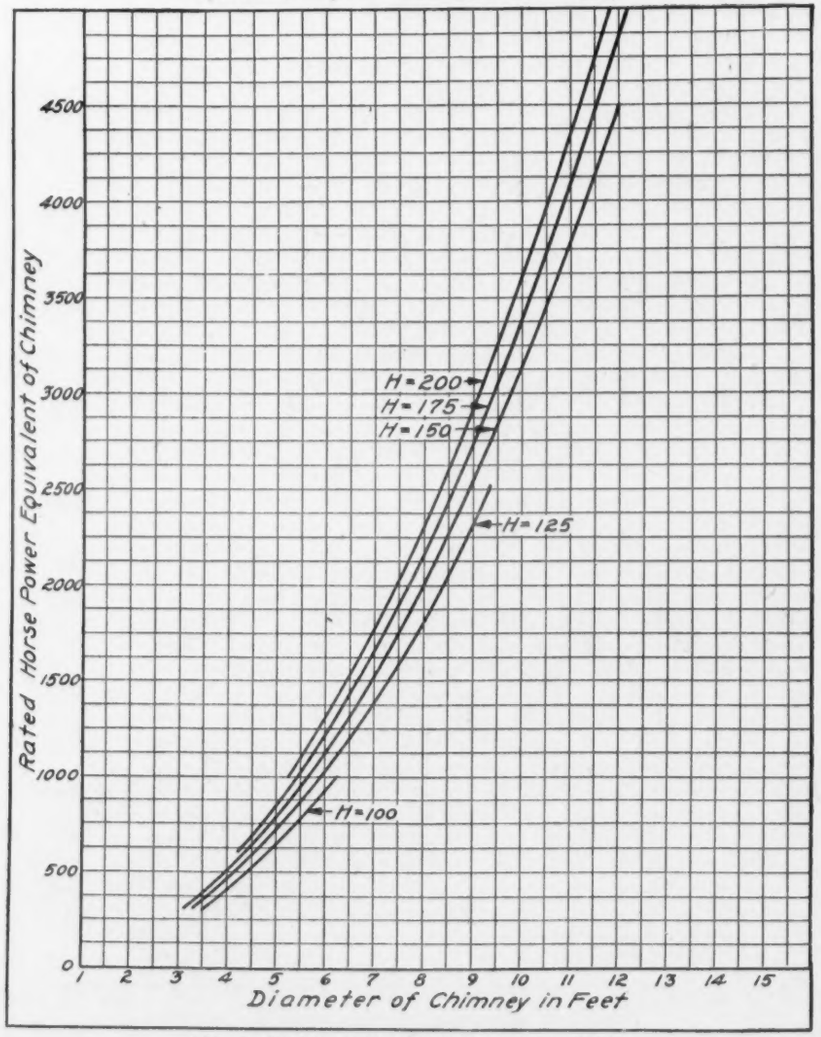


FIG. 4—CURVES GIVING DIAMETERS OF CHIMNEYS

to enable a foundry to operate and make prices based on normal conditions.

With the four principles incorporated in the cost system, and the eight requirements met, the following may be expected as results:

Elimination of guess work in price making.
Knowledge that all items are included.
The right kind of a basis for predetermining production rates and costs.
Intelligent apportionment of overhead.
Comparison of work between different plants.
Close watch on work running over estimates.
Discouragement of price cutting.
Better prices.
Stronger institutions financially.
Valuable data.
Betterment to the entire industry.

In presenting this argument more attention has been paid to principles, laws and economic considerations than to the methods and forms, which after all are only incidental considerations.

If the basis of investigation is right, the factors have to do with gathering and compiling cost data are easily within the control of any competent cost accountant or organization specializing in cost accounting.

Composition Alters Properties of Copper

INFLUENCES governing the physical condition of copper are outlined in a paper prepared for the February meeting of the American Institute of Mining and Metallurgical Engineers, by Frank L. Antisell, superintendent of the Raritan Copper Works, Perth Amboy, N. J. In discussing the pitch and set the author says that the appearance of the surface of the copper when cooled is considered as to its *pitch*, or the general contour of the surface and the shape, which may vary from a concave to a convex. The *set*, is the detail appearance of the shape, the wave-like structure. When the shape presents a concave surface, it is known as *low pitch;* a convex surface is known as *high pitch* or *tough pitch*, and a level surface is called *flat pitch*. The set of the copper is, in a very large measure, directly related to the pitch; and so intimately are these characteristics connected that they are often used as synonymous terms by the refiner when he is speaking of well-refined copper. If, however, he is speaking of unhealthy or improperly refined copper, he will define both the pitch and the set. The character of the set will show whether the copper is low pitch but healthy, or low pitch but unhealthy and must be refined again. High-pitch copper is usually described in terms of the set. If the set is very close and even, the copper contents are about 99.95 per cent. This close set cannot be produced on a shape with a low pitch.

The influence of oxygen is discussed by the writer who calls attention to the fact that metallurgically, the copper presents the best general characteristics when shapes of a certain size present a slightly convex contour, high pitch, with a good set and close grain. While a shape of a certain weight presents a satisfactory appearance, it does not follow that larger or smaller shapes will be the same. As a general rule, the thicker the shape, the less oxygen is permissible in it; the thinner the shape the more oxygen may be present. Oxygen is, therefore, often spoken of as a medicine for copper, it being used to regulate the pitch. While the pitch may be flat or slightly convex, it may be decidedly inferior if it presents a coarse grain.

Copper containing an excessive amount of oxygen that is introduced during the refining period is known as *set* or *dry copper*. As the amount of oxygen decreases and approaches the percentage found in satisfactory metal, the copper is said to be underpoled. When the metal is thoroughly refined, it is known as tough pitch. The fracture of tough copper must exhibit a decided metallic luster; a brick-red shade is indicative of undesirable oxygen contents. With low oxygen contents, copper may be heated over a long period with the formation of a very slight coating of oxide, while with higher oxygen contents, the copper oxidizes quickly.

The general physical properties of copper change in a marked manner with the increase of sulphur it is said. An increase in the sulphur contents affects the number of bends in a very much greater ratio than does oxygen. Unhealthy copper contains slight quantities of gases, such as hydrogen, carbon monoxide, sulphur dioxide, and carbon dioxide. If an attempt is made to remove the excessive oxygen, the copper will spew; that is, a miniature volcanic action will occur in the shape and the copper will be known as overpoled. Copper in this state will be low in electrical conductivity and have a small reduction in area, due to several reasons, particularly the excess of oxygen. These properties can be improved only by subjecting the entire charge to a refining process, which consists of oxidizing the copper, thus removing the reducing gases, and then poling the copper up to a tough pitch. Unhealthy copper may present either a high or a low pitch, but if an attempt is made to raise the low pitch, the copper will spew.

Proper care in the annealing of copper is often neglected, it is pointed out. On this account the maximum elongation is seldom obtained, and this is necessary where the metal must stand a large amount of work in being fabricated. Extremely tough-pitch copper exhibits great ductility, and if it is given improper treatment in the mill it may tend to shred or tear the surface of the copper.

When such a piece of copper is pickled, the shreds, not being oxide, do not dissolve in the solution, thus resulting in an imperfect surface. If the copper is not so tough, these slivers may be entirely detached or will not be formed at all, due to the thick veneer of scale. While copper may occasionally be preferred with such properties, it is at the expense of the physical characteristics of copper.

Increases Blower Plant

The Ohio Body & Blower Co. is a natural outgrowth of the Ohio Blower Co., Cleveland, which started 18 years ago to manufacture a patented exhaust head and also to manufacture and install dust collecting systems. Other lines which include steam and oil separator steam traps, water level control valves, feed water heaters, ventilators, core ovens and core oven equipment were added from time to time. The company furnished the government a large quantity of standardized ship cowls complete with turning gear, during the war.

Immediately after the armistice was signed the company decided to enlarge the plant and enter extensively into the production of motor car bodies. The new branch [illegible] ness has been working to capacity since its inception. The company now operates three plants and it is proposed to add another unit to the new plant in the spring. The change in the name of the company will not affect the personnel in any way.

Melting Iron With Powdered Coal

Small Air Furnace Melting Malleable Iron is Equipped With a System For Burning Powdered Fuel—Comparison With Handfiring Shows Economy of New Installation

POWDERED coal for some years has found favor among malleable-iron foundries. Its main use has been confined to annealing furnaces until within the past year, when equipment has been installed which uses this fuel as a melting agent in air furnaces. At the plant of the National Malleable Castings Co., Chicago, is a particularly interesting powdered-coal burning system which has been under observation for the past six months. This installation was made by the Combustion Economy Corp., Chicago.

The complete equipment, which was manufactured under patents held by A. J. Grindle, president of the Combustion Economy Corp., includes a storage hopper, a system of screw feeds which deliver the coal into an air passage where by a series of mixing devices the air and fuel are blended thoroughly and delivered through a pipe into the main combustion chamber of the air furnace. Five burners are provided, each being fed by a separate screw, but only three burners have been connected to the furnace. These furnish ample heat, as the furnace has only 10 tons capacity and the normal melt is 9½ tons. The length between bridge walls is 15½ feet; the width at the tap holes is 5½ feet; the firebox is 40 x 59 inches; the diameter of the stack is 29 inches; the height of the wall at the tap holes is 31 inches, and the depth of the bath at the tap holes is 9 inches. The only changes made to adapt this furnace to powdered coal melting consisted in raising the front of the firebox from 3 to 6 inches, filling in the ash pit, lowering the front bridge wall and removing the top blast. Hand fired coal was used previous to installing the powdered fuel burner.

The burning system has a number of features which are unique in powdered coal firing practice. A typical installation and one which resembles that at the Chicago plant of the National Malleable Castings Co. is shown in Fig. 2. The main point of difference between the latter and the type shown in Fig. 2 is the use of a separate motor to drive the coal feeding mechanism at the National foundry. This motor is connected through a special variable speed drive to the line shaft which operates the individual feeding screws through gears.

The tendency of powdered coal to pack at the point where it is delivered from the storage bin is obviated by a liberal opening in the bottom of the supply hopper, which feeds the three worm feed pipes. A specially designed four-flight screw in each of these delivers a continuous flow of coal at the outlet of the delivery chamber. Packing, which is a common source of trouble shown by an intermittent or pulsating flame, is entirely absent in this type worm-feed.

At the delivery end of each screw

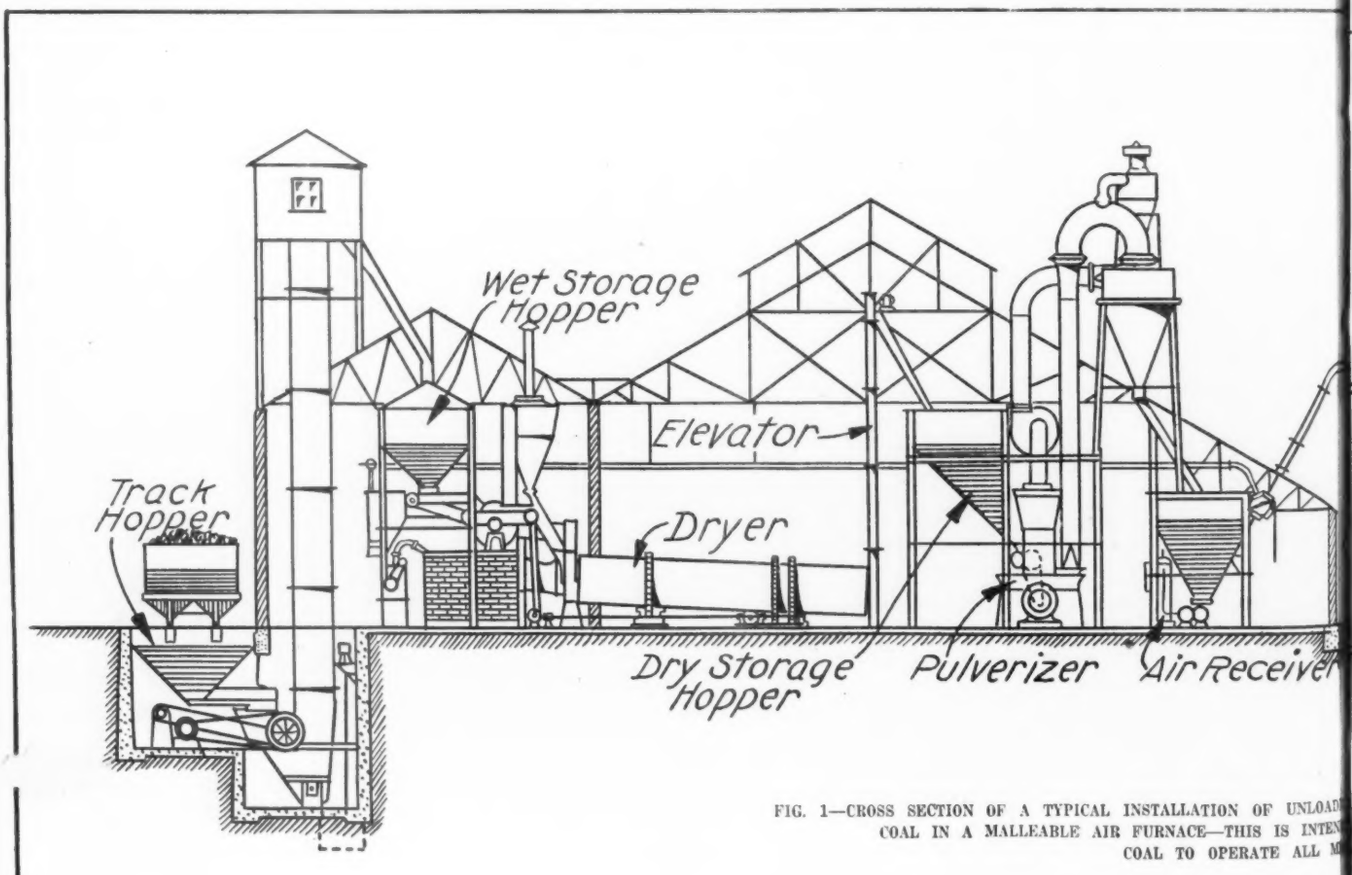


FIG. 1—CROSS SECTION OF A TYPICAL INSTALLATION OF UNLOADI
COAL IN A MALLEABLE AIR FURNACE—THIS IS INTEN
COAL TO OPERATE ALL M

shaft is a disk, keyed to the shaft and provided with a series of spiral ridges on the surface which is at right angles to the entering stream of coal. This disk resembles the plate used in an old fashioned coffee mill or corn sheller. The ridges in the surface radiate from the center to the outer edge. When the stream of coal strikes this rotating disk, it is broken up and thrown outward by centrifugal force, aided by the ridges in the face. Here the entering blast of air strikes and mingles with the powdered coal, carrying it upward through the conveying line shown in Fig. 2. Just beyond the upward bend of the conveying line is a stationary mixer which fills the entire circumference of the conveyor. This is supplied with a number of vanes set at different angles, which act as baffles and impart a whirling motion to the entering column of air and powdered coal. This gives a more intimate mixture of the two elements before they reach the nozzle or point where combustion starts at the entrance to the furnace. The distance from the point where the screw delivers the coal into the air line, to the carburetor indicated in Fig. 2 may be from 3 to 100 feet.

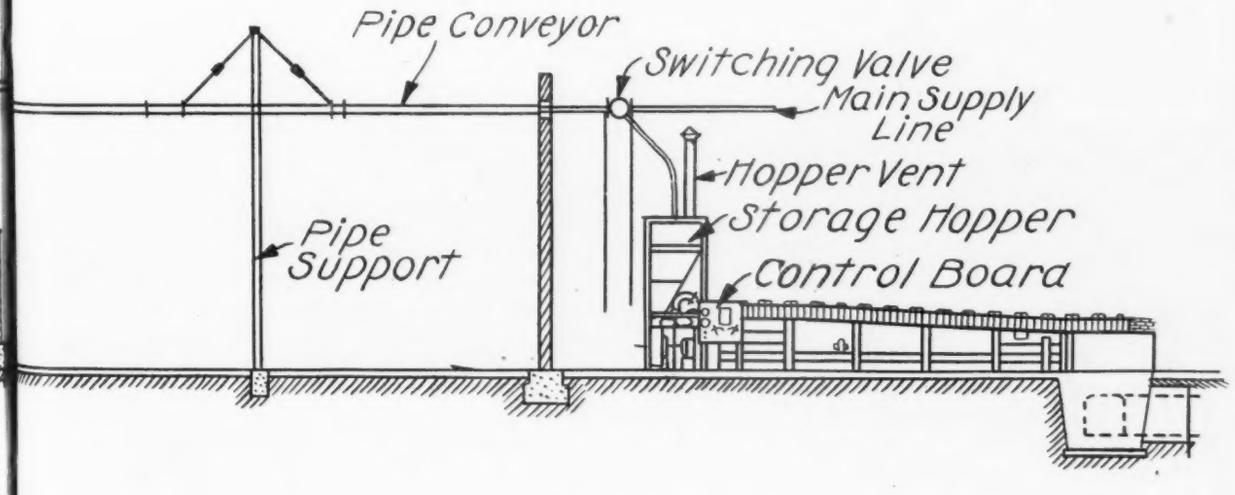
Air for the system is supplied by a low pressure blower direct connected to the driving motor. The air is controlled by a specially designed gate with an indicator showing the number of square inches of opening in the supply pipe. In addition, adjustable markers corresponding to determined coal screw speeds enable the operator to sycronize the coal and air supply by setting the indicator to a corresponding number. By this method, the markers may be set in accordance with the carbon-dioxide analysis of the stack, and no variation is necessary unless the grade of coal used is changed. This relieves the melter of some responsibility, for when the proportion of air and coal is once determined, the sycronizing device assures the constant maintenance of the correct mixture for the best combustion. A speed change box connected to the coal screw shaft provides accurate control over the amount of coal which is fed into the air line. This speed changing device is marked to indicate the amount of fuel which is delivered at each point in the regulation.

The outer or delivery end of the carburetor is flattened into an oval

Table I

Record of Typical Day's Run with Powdered Coal

		1st Heat	2nd Heat	3rd Heat
Start		1:30 A. M.	8:10 A. M.	1:05 P. M.
Heat ready		4 hrs. 30 min.	3 hrs. 40 min.	3 hrs. 25 min.
Heat out		6 hrs. 15 min.	4 hrs. 15 min.	4 hrs. 5 min.
Tons melt		9.21 tons	9.24 tons	9.19 tons
Melt per hour total time		1.47 tons	2.17 tons	2.25 tons
Melt per hour until hot		2.46 tons	2.58 tons	2.68 tons
Pounds of coal used		7215 lbs.	4973 lbs.	4775 lbs.
Coal per ton		783 lbs.	538 lbs.	508 lbs.
Per cent of coal to iron		39.6%	26.9%	25.4%
Per cent pig iron in charge		42.7%	40.8%	41.24%
Silicon in charge		.985%	.976%	.976%
Manganese in charge		.46%	.58%	.58%
Analysis of metal produced	Silicon	.82%	.83%	.85%
	Sulphur	.07%	.068%	.076%
	Manganese	.33%	.37%	.44%
	Carbon	2.00%	2.58%	2.66%
Tensile strength		53,800	56,150	53,000
Elongation in 2 inches		13%	11%	12.5%



SHING, DRYING, CONVEYING AND BURNING SYSTEM FOR USING POWDERED
USE IN A PLANT WHICH WILL PREPARE SUFFICIENT
AND ANNEALING FURNACES

shape, with the long axis horizontal. This allows the flame to spread out across the furnace and ignite more readily. In operating at the Chicago malleable plant, the proportion of air and coal is so adjusted that a short direct flame melts the metal at the start of the heat. When the bath is thoroughly melted, the flame is lengthened and directed in such a manner that a current is set up over the surface of the molten metal. This pushes the slag toward the back of the furnace and assists in mixing the entire bath in a way which promotes homogeneity.

Average practice with the system at the National Malleable plant requires two or three melts a day, although at times only one melt is made. Between Sept. 9 and Dec. 3, 1919, 84 heats were melted in this furnace. Table 1 gives the record of an average day's run. In this case three heats were made. The first was melted within 4 hours and 30 minutes, the second in 3 hours, 40 minutes and the third in 3 hours and 25 minutes.

A control board has been devised, to furnish a guide for the melter operating the powdered coal equipment. Data secured from actual trials provide a guide for the proper control of apparatus on all other heats. Thus the proper air inlet, together with the best screw feed speeds at the start of the heat were determined. Then the time interval until the next change was necessary was noted. An adjustment in the relative quantity of air and the amount of coal fed was made when the slag was skimmed, when tests were made and when the heat finally was ready. These were noted with the corresponding time intervals. The control board carries these data, and shows the operation of burner system in a simple manner.

A continuous strip of paper, marked off into the hours of the day and 20-minute intervals is mounted on two rollers back of the cardboard face of the control board. The proper adjustments of air and coal feed at the various intervals are indicated in columns to the left. The quantity of air delivered is shown by numbers corresponding to the three air inlet openings, while the revolutions per minute of the three coal feed screws, which are operated through gears from a common drive shaft, are indicated in another column.

In using the control board, the slip containing the time intervals is rolled around until the hour of the day when the flame is lighted is shown opposite the start position on the control board. Then the necessary changes in air or coal feed are shown opposite the required time on the board. A typical instance showing the use of the device for an initial heat is shown in Fig. 3.

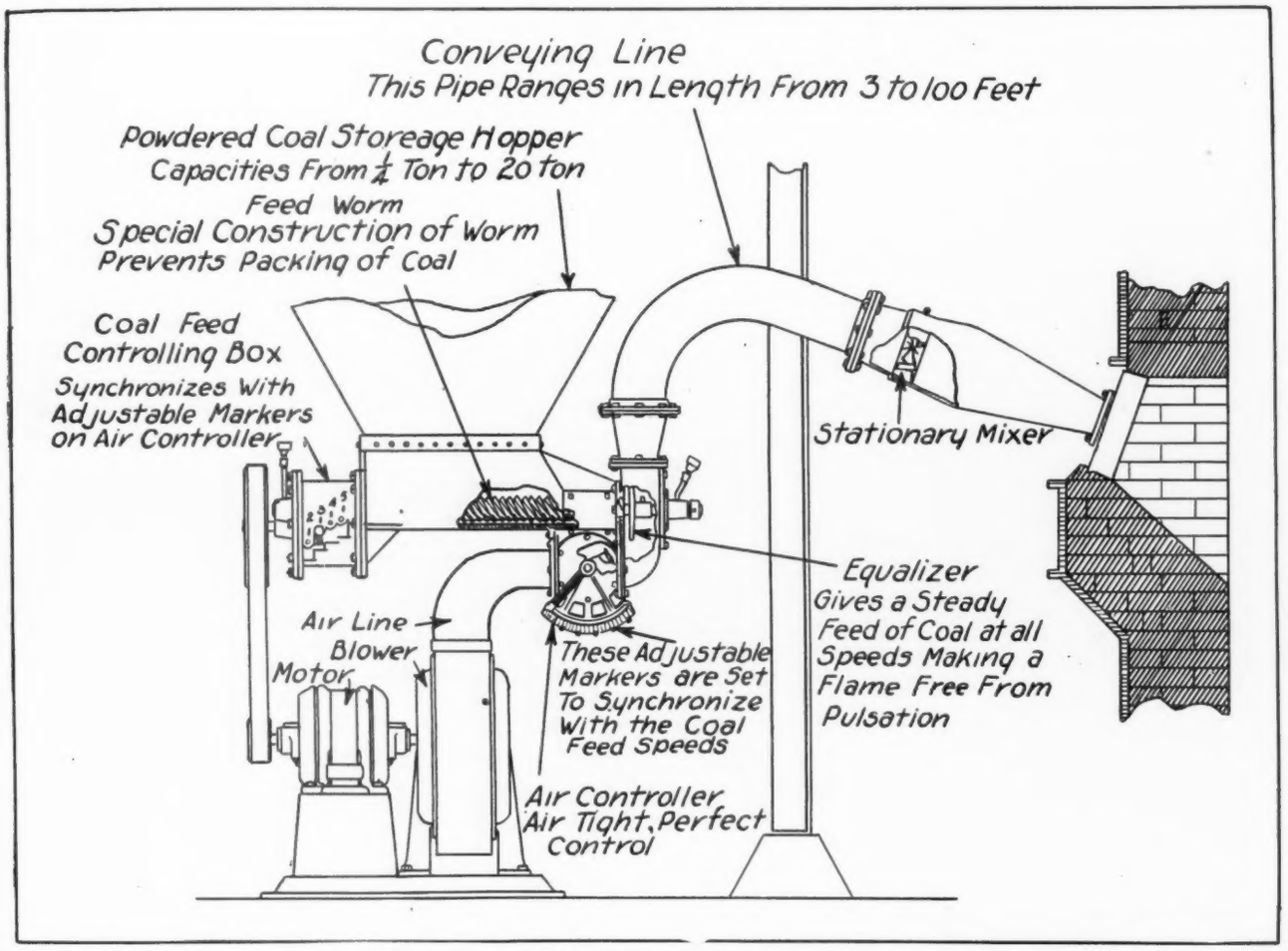


FIG. 2—DETAILS OF A POWDERED-COAL BURNING SYSTEM, SIMILAR TO THAT INSTALLED AT THE CHICAGO PLANT OF THE NATIONAL MALLEABLE CASTINGS CO.

A close study has been made of the economy of powdered coal at the plant of the National Malleable Castings Co. The chief chemist, John Birdsong, together with A. J. Grindle, of the Combustion Economy Corp., has compiled comparative cost figures using as a basis data which were secured when the furnace was hand fired with coal and those which have been obtained with the powdered fuel.

Table I gives a record of an average days run, using powdered coal. In this case the first heat was held 55 minutes awaiting the arrival of molders to pour the metal. This

delay resulted in the consumption of 1072 additional pounds of coal. Pouring was started at 6:35 a. m., but sufficient labor was not at hand to pour continuously and leave the tap hole open, until 6:55 a. m. This increased the ratio of coal to iron from 33.3 per cent to 39.6 per cent. The slight loss of silicon shown is commented upon as a factor of economy. A larger proportion of scrap may be used in the charge, as it is not necessary to add pig iron to compensate for the loss in silicon. It is said that the loss in both silicon and carbon is less in powdered-coal burning furnaces. The average amount of pig iron used in the furnace when hand fired was 47 per cent. With powdered coal, this was reduced to 41 per cent.

The costs given in Table II are compared upon a common-basis of cost for labor and materials. The powdered coal costs were taken from a five day run during which 11 heats of 9½ tons were taken. The difference in iron cost is attributed to the saving due to the use of scrap. In this case the cost of pulverizing the coal was charged at $2.68 which is higher than the cost would be in a plant in which a large amount of coal is handled.

An analysis of the coal which was used in this test follows:

ANALYSIS OF COAL USED

Moisture	1.64
Fixed carbon	54.98
Sulphur	.768
Volatile matter	37.43
Ash	5.95
B.t.u.	13,605

SIEVE TEST

200 mesh	76%
240 mesh	72%
300 mesh	56%

As may be noted from Table II, a saving of $1.043 per ton is shown by using the powdered coal process on this furnace. The saving in a melt of 9½ tons therefore is $9.908 or $19.816 per day with two heats per day. If conditions required, three heats per day could be obtained without difficult, and better economy would be shown in the heats which are made after the furnace is hot.

A smaller amount of slag is formed in the furnace now than when hand firing was used. This is explained by the lower percentage of silicon, manganese and carbon which are oxidized from the metal. The ash from the powdered coal does not make up for this decrease in quantity of slag as is shown by the amount of material which is skimmed from each heat. The powdered coal equipment reduced the slag from seven or eight truck loads to three or four truck loads. The ash which is deposited in the bottom of the stack averages about three wheelbarrow loads a week at the present time.

It will be recognized that the furnace to which this equipment was applied is small. The makers state that greater savings can be shown with a larger furnace. Further economy in actual operation will be possible when conveying equipment which has been purchased is in use. The present crushing and drying plant will provide sufficient fuel for additional air furnaces, as well as annealing ovens which have used powdered coal for a number of years.

A typical powdered coal installation including the crushing and conveying equipment, is shown in Fig. 1. At the left is the crushing, drying and transferring machinery. Coal is unloaded at the extreme left, passing down into a hopper and thence by an elevator to a hopper which feeds into the wet storage hopper. The coal next is passed over a magnetic

(*Concluded on page* 150)

Table II

Comparison of Costs Between Hand-Fired and Powdered Coal Burning Methods

	Cost of average hand firing	Cost of powdered coal firing	Savings of powdered coal per ton	Savings of hand fired per ton
Labor	$ 1.090	$ .743	$ .347	....
Iron	22.040	21.517	.523	....
Coal	2.565	2.630	.000	.065
Skimmers	.184	.145	.039	....
Brick	.795	.561	.234	....
Extra electric power	.000	.035	.000	.035
Total	$26.674	$25.631	$1.143	$0.10
Net savings of powdered coal per ton melt	.....	.....	....	$1.043

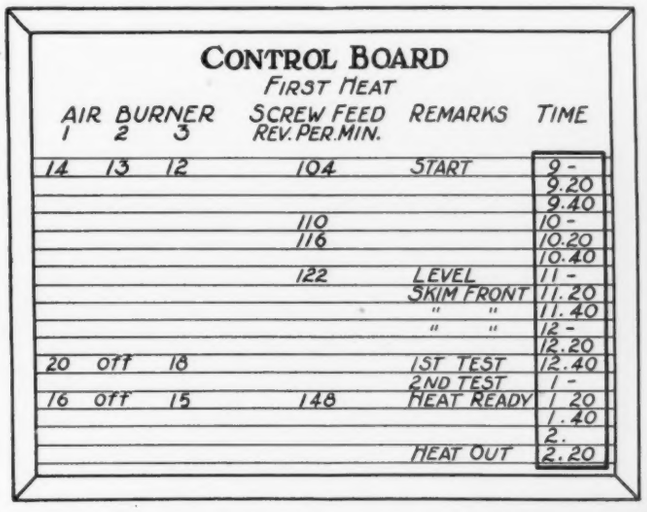


FIG. 4—DETAILS OF THE CONTROL BOARD DESIGNED AS A GUIDE FOR THE MELTER

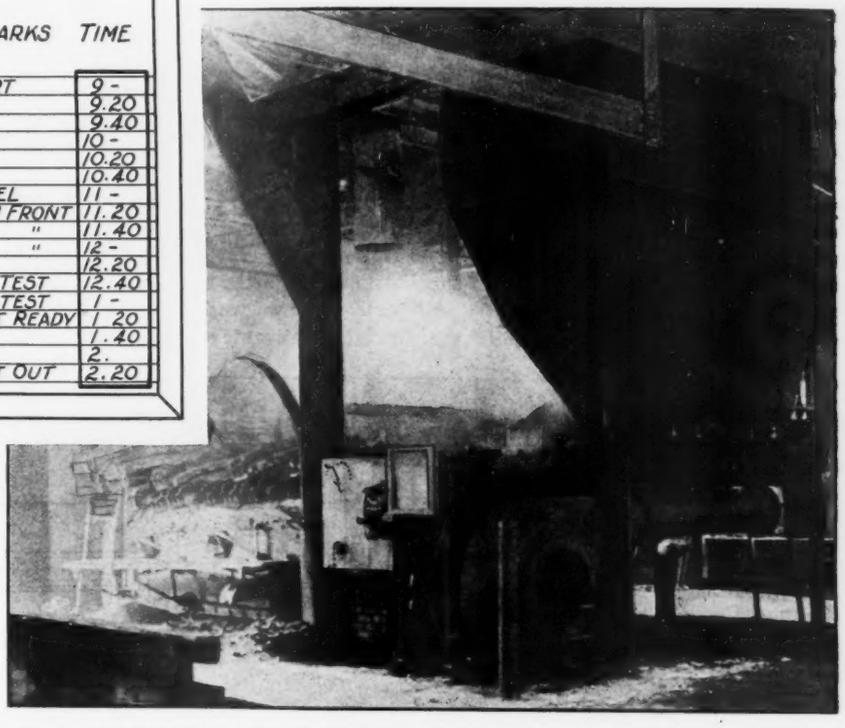


FIG. 5—POWDERED-COAL BURNING EQUIPMENT USED WITH A MALLEABLE-IRON AIR FURNACE

Castings For Ship Construction—XX

To Conserve Floor Space it is Recommended That a Pit be Bricked up in the Floor Corresponding in Shape to the Required Casting—Contraction Problems Discussed

BY BEN SHAW AND JAMES EDGAR

THE type of frame shown in the accompanying illustrations is the customary design for large vessels. It is one which presents unusual difficulties and one in which more than ordinary skill and judgment are called into play to produce a sound casting. Making the frame in two sections and afterward securing it by means of a scarph joint simplifies the molding to a certain extent and also aids the foundryman when providing methods to allow contraction of the casting to take place after the metal has become solidified. The shrinkage feature in large work of this kind is one of the most important problems to be considered and, as a rule, each job supplies a problem which requires individual solution. The intervening stiffeners are mainly responsible for these difficulties, because they offer an obstruction during the period of shrinkage and contraction. However weak the composition of the drawbacks may be, to allow the crushing action to take place, they must be strong enough to withstand the rush and pressure of the metal while the mold is filling. The length of the base part of the frame to which the keel plate is attached is approximately 40 feet, and the allowance for shrinkage would therefore be about 5 inches, varying with the composition of the metal used.

Providing for Contraction

It obviously is necessary when preparing the mold to provide some means which will allow for ready and uninterrupted contraction. The wedge method which is capable of so many variations, is very useful in such an instance as this, and its successful application removes the need for crushing the drawbacks to the same degree. The usefulness of the method is increased when there is comparatively little change in the sectional shape, or when the change is distributed gradually over a long length of the casting.

Owing to the size of flasks which would be necessary, the great length of the job leaves no other alternative to bedding in the floor. When making long narrow work of this character it is an advantage to limit the area taken up on the foundry floor, to facilitate drying and reduce labor. A good plan is to brick up the walls of a pit following the contour of the job to be molded, and dig out a depth slightly below the joint of the bottom drawback. Sometimes this brickwork is tapered and faced off in places with facing sand to form a side joint for the drawbacks; or the brickwork may be vertical, and a coating of sand applied to give the necessary taper. In a third method the drawback joints are made up well inside of the brickwork, in which case a larger area will be required in the foundry floor. In exceptional cases it may be considered advisable to form the back of the drawbacks against cast-iron plates resting against supports carried by the grids. When this method is adopted there is clearance between the brickwork and the drawback which usually is loosely rammed prior to pouring the casting. This last method is advantageous when it is necessary to ease the mold directly after casting the metal, since the backing plates of the drawbacks then can be removed giving access to the inside.

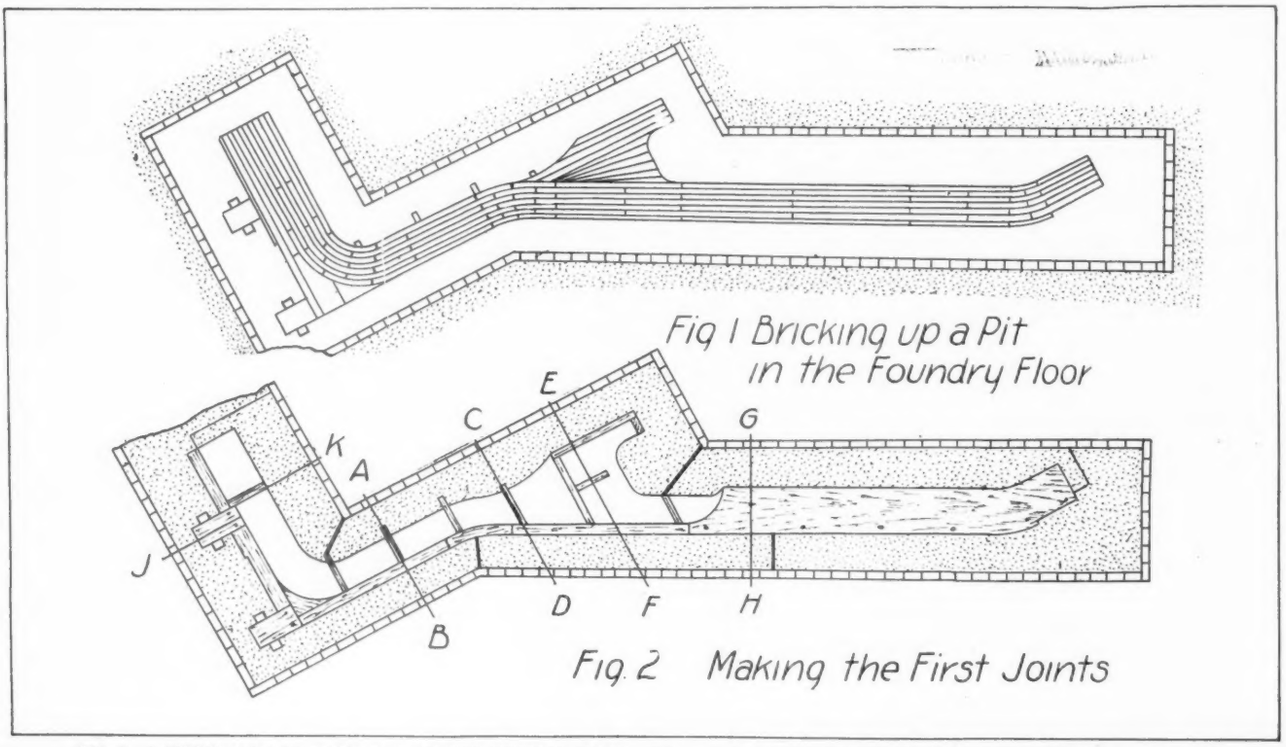


FIG. 1—A TEMPORARY PIT BRICKED UP IN THE FOUNDRY FLOOR FIG. 2—THE PATTERN AND PIT AFTER THE FIRST JOINT IS MADE

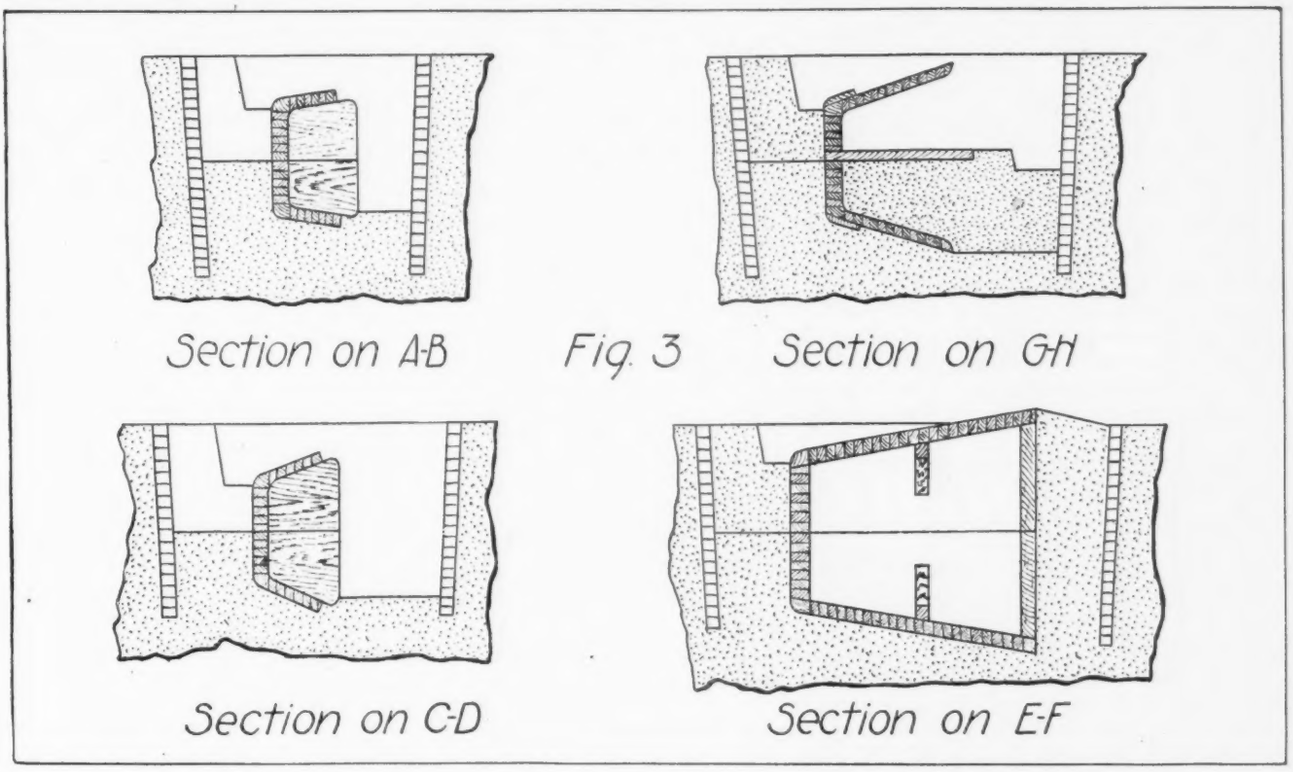


FIG. 3—SECTIONS TAKEN AT VARIOUS POINTS ON THE PATTERN SHOWING THE PARTINGS AND SHAPE OF DRAWBACKS NECESSARY

The illustration, shown in Fig. 1, gives the approximate shape of the brickwork which is found useful in making the frame indicated. The half pattern is laid upon the foundry floor as shown and the outline marked in the sand. Then the sand is removed, until a hole deep enough to take the full depth of the work is formed. Though the pattern as constructed is comparatively strong, its length tends to create difficulties in handling, hence considerable care must be exercised in bedding in the bottom half. Supports or jigs should be used at each end, fitting over the sectional shape and coinciding with the joint of the pattern. These assist in maintaining the true alignment of the work. During the process of ramming the sand under and around the half pattern the level should be kept in constant use. The quickest method of leveling the pattern is to build up a number of

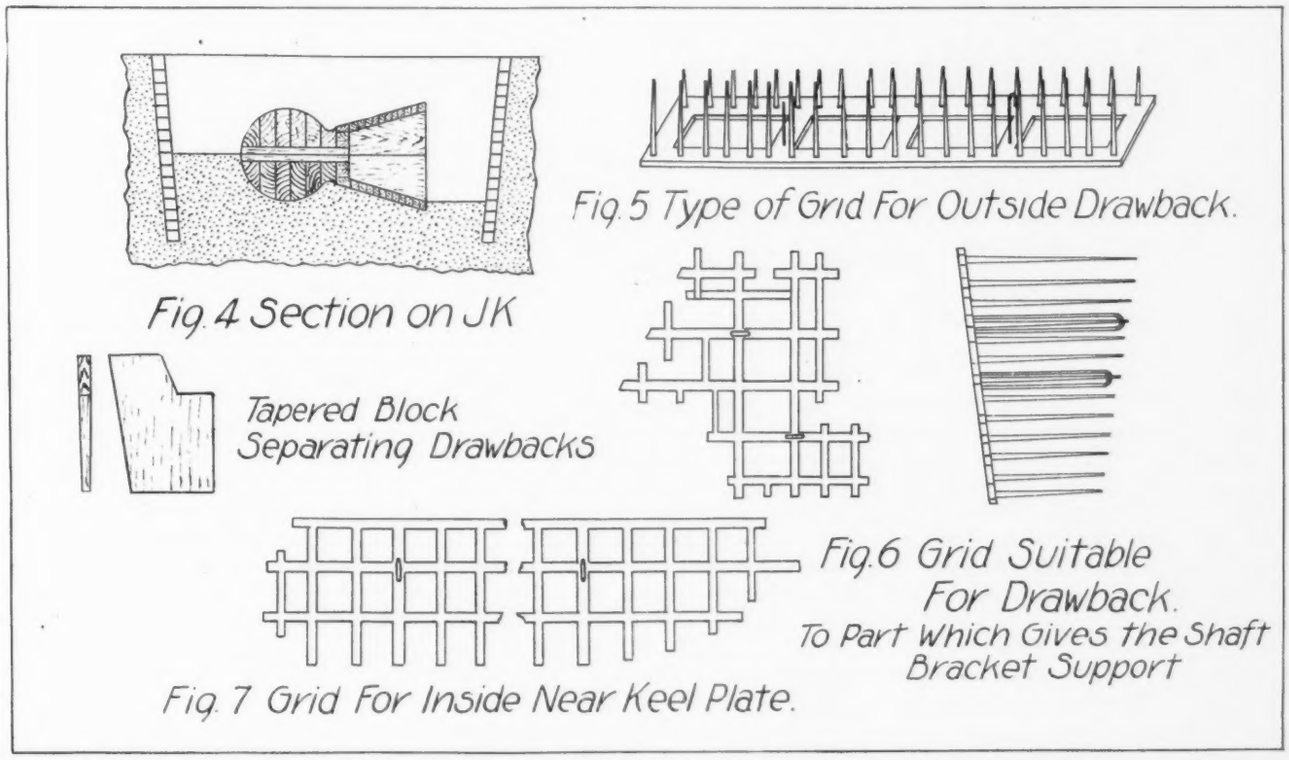


Fig. 5 Type of Grid For Outside Drawback.
Fig. 4 Section on J K
Tapered Block
Separating Drawbacks
Fig. 6 Grid Suitable
For Drawback.
To Part Which Gives the Shaft
Bracket Support
Fig. 7 Grid For Inside Near Keel Plate.

FIG. 4—SECTION AT *J K* FIG. 3 FIG. 5—GRID FOR OUTSIDE DRAWBACKS FIG. 6—DRAWBACK GRID FOR SHAFT BRACKET SUPPORT FIG. 7—GRID FOR INSIDE NEAR KEEL PLATE

bearings with the pattern in position, constantly trying with the level to get the right setting. When these resting places have been formed the pattern should be lifted to remove the bottom screws by which the stiffeners are secured, leaving the side screws in to maintain their positions. The pattern having been returned to its former position can then be rammed up, all the screws holding the loose pieces being removed just prior to the final ramming up and after the main section of the pattern has been bottom part of the pattern without disturbing the mold to any appreciable extent. When the pattern is very short it can be more easily handled and remains in a more rigid condition, and outside drawbacks need not be used. The plan view of the half pattern rammed up to the first joint is shown in Fig. 2. During the time of ramming the outside, wedge shape pieces of wood are set in the sand as indicated by the heavy lines on Fig. 2. These pieces should be carried the full height of the work, inner drawbacks are shown in Figs. 6 and 7, the former being a convenient form for the bracket section shown in *EF* of Fig. 3, and the latter a type used for the drawback near the keel plate end, shown by section *GH* in Fig. 3. This drawback is more conveniently made in two pieces, hence the first piece can be completed and the joint made for the upper one before the top section of the pattern is placed. When the work has advanced sufficiently and the full pattern is set, the outside drawbacks can be

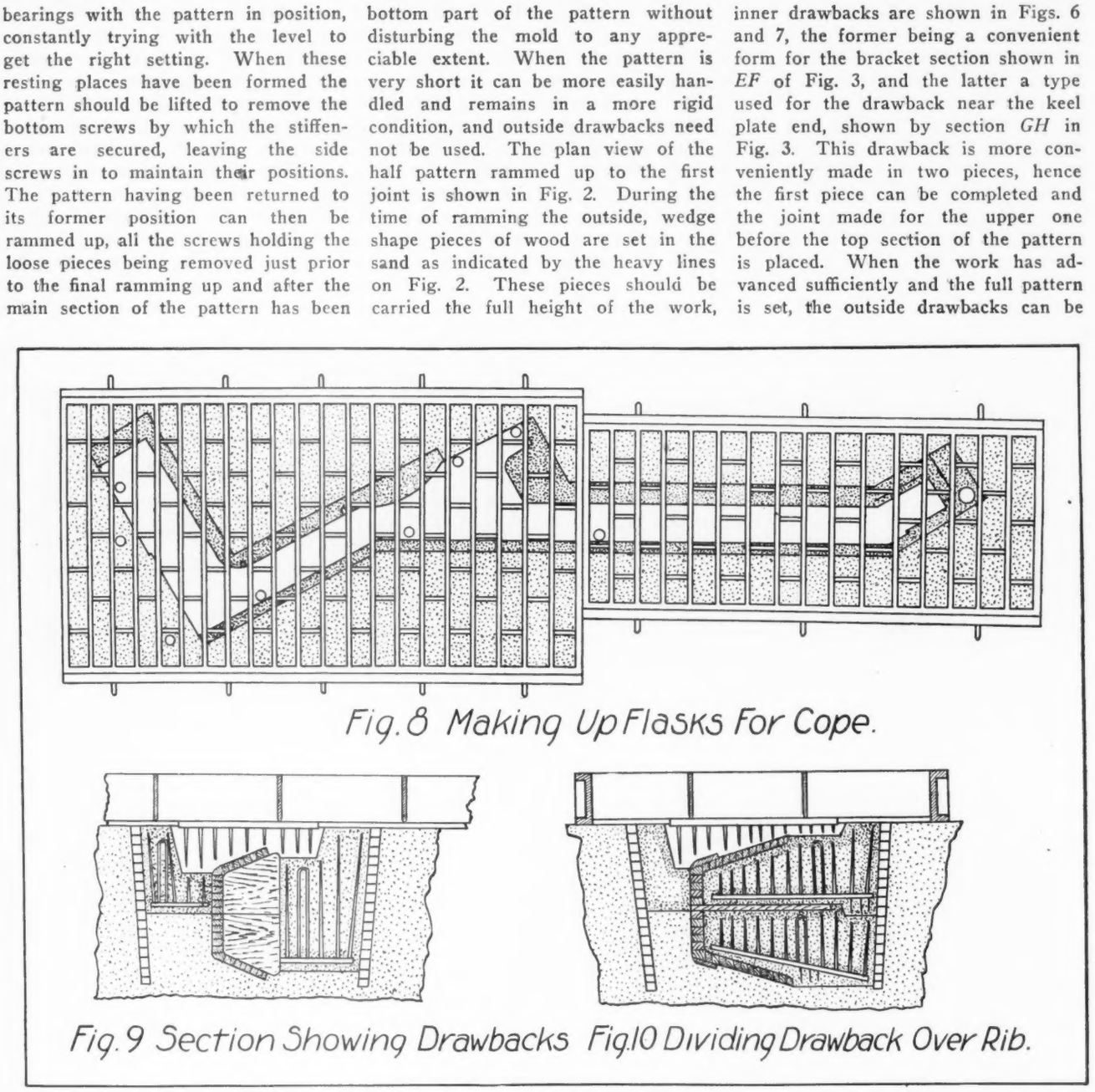


FIG. 8—SHOWING THE MOLD COVERED BY TWO SEPARATE COPES FIG. 9—TYPICAL SECTION SHOWING DRAWBACKS IN POSITION FIG. 10—THE DRAWBACK OVER HORIZONTAL RIB IS MADE IN TWO SECTIONS

well set. The supports at the ends can be removed and their impressions filled in with facing sand.

When the pattern is definitely set, arrangements may be made for jointing the mold. There are a number of ways by which this can be done, the method shown in this article being that most commonly practiced. Owing to the great length of the pattern it is necessary to form a joint along the outside coinciding with the joint of the pattern and on the inside the joint is formed to follow the contour of the inside of the web of the channel section. It is necessary to keep the first joints as far down as possible to allow the free withdrawal of the being cut at the joints for convenience in working. The impressions left by these wedges are filled with grids or plates carrying a coating of molding sand to give the desired shape. The various sections shown in Figs. 3 and 4 illustrate the joints in their relation to the bottom half of the pattern. Before the top half of the pattern is set the channel drawbacks should be commenced in order that the grids to carry them may be set in position. These drawbacks are divided into convenient sizes and wedge pieces are prepared and placed as indicated in Fig. 2 while working up the bottom of the drawbacks.

Two forms of grids suitable for the proceeded with. There is not the same need for precaution in connection with shrinkage on the outside, and a different form of grid can be used to carry these drawbacks, the form shown in Fig. 5 fulfilling requirements.

All of the many screws connecting loose pieces must of necessity be removed during the process of ramming these drawbacks and steps must be taken to maintain the position of the bottom halves of the stiffening ribs. The building up of the inner drawbacks after the pattern is placed, requires more time since the composite must be tucked under the top web of the section. The joint follow-

ing the surface of the middle web shown in section *GH* Fig. 3, should be checked back as shown to form a guide for the top portion. It gives the added advantage of counterbalancing the projecting core and this together with the support given at the ends render chaplets unnecessary when closing the mold.

The joint is formed after both sides are worked up to the extreme points of the pattern, following the lines of the section, and keeping as near to the top surface as the curve on the outer edge will allow. A flat bearing is provided parallel to the first joint, and then gradually tapered up to a levelled surface flush with the foundry floor and with the top of the brick wall of the pit. The general formation of these joints is more clearly indicated in Figs. 9 and 10. The top will not show a varying depth from the levelled surface, being least around the bracket for carrying the palms of the propeller shaft bracket, and greater near the rudder post connection.

It is sometimes quite a difficult proposition to carry the cover for the whole in the top flask because of the bulk of hanging sand. Under such circumstances it is preferable to reduce the top lift by forming parts of the cover as cores. This method is very often adopted, as besides dispensing with a quantity of tackle and reducing the possibility of a bad lift, it eliminates the possibility of crushing when fitting the mold together. When the lift can be taken conveniently with the cope flask, grids are frequently used to support the sand rather than a large number of gaggers. When such a method is adopted much of the ramming can be done before the cope flask is placed in position. Whichever method is adopted, however, the cope must be tried on so that the position of the runners and risers may be determined and provision made accordingly for the requisite clearance between flask bars. In Fig. 8 a method is shown whereby two flasks are used end to end to make up the necessary length of the job. It is quite usual in dealing with such long work to make use of a number of flasks for the cope, the kind and character of stock flasks determining the number required. The number used should be as few as possible, consistent with lifting facilities.

The sand joint between the parts should be tapered one way and the parts should be lifted according to the direction in which such joints are tapered. Stakes or guides should be fixed for each flask used to insure accuracy for each setting. When convenient it is preferable to allow freedom of access to the wedge pieces through the cover flask, so that after the job is cast they can be removed without disturbing the cope appreciably.

The pouring of such a casting is best accomplished from one end, preferably the end to which the keel plate is attached. A large gate should be carried the full depth of the work at the joint indicated on Fig. 8, so that a runner may be formed the full depth of the bottom of the channel section and against the drawback. The position of suitable risers is also shown in the same illustration. When the position of the cope flasks has been determined they can be removed until the grids are rammed. The relation between drag and cope, with the grids of the drawbacks more clearly defined is shown in Figs. 9 and 10. These illustrations also show the type of grid, with gaggers, useful for taking the top lift. They may be either secured to the cope flasks or used in strengthening separate bodies of sand

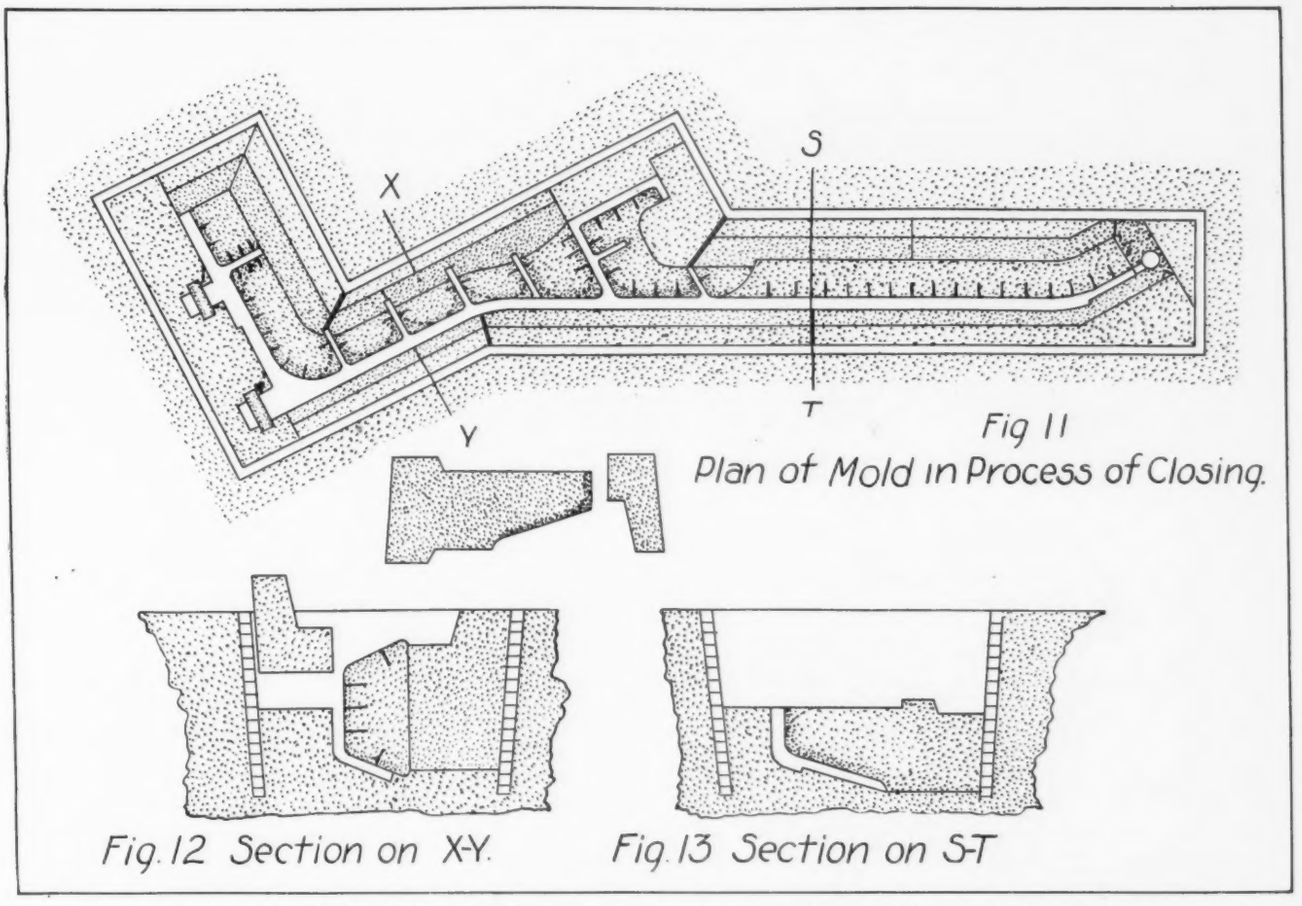


FIG. 11—PLAN OF MOLD PARTLY ASSEMBLED FOR CLOSING FIG. 12—SECTION AT *X Y* FIG. 13—SECTION AT *S T*

to form covering drawbacks. With the cover grids set and the whole tap rammed up, with gates and risers in position, the cope flasks may be replaced and the whole rammed up. When the flasks lend themselves to the removal of the wedge pieces, covering blocks of wood can be set between the flask bars to correspond to the position of the wedges. After the job is cast these blocks may be removed in order to give ready access to the wedges which may be hooked to a crane and withdrawn with little difficulty.

Having completed the ramming, the process of stripping can be proceeded with. The cope flasks are removed, and if the lift is small due to using cores, they may be turned over for convenience in working. If, however, the full lift is taken with the cope flasks it is rather a precarious undertaking to roll them over, hence they are usually set on supports and all finishing work done from underneath. The outside drawbacks should be removed first and when the screws into the ribs are removed the top section of the pattern is clear and can be removed. The top drawback covering the horizontal web is next lifted, and the web unscrewed from the lower half of the pattern. The wedge pieces can be withdrawn and then all the inside drawbacks can be lifted in their turn. They will of course carry the stiffening ribs and webs around the palm bracket with them. Considerable floor space is required for housing these drawbacks, and they should be placed as conveniently as possible for working. When all drawbacks are withdrawn, the lower shell of the pattern is practically free, and can be lifted fairly easily. It is advisable however to use a long bar for this purpose, in order to keep the pattern as straight as possible to clear the mold. When the various parts of the pattern have been drawn out of the mold, the process of nailing, slicking and generally cleaning up of the mold and drawbacks is begun. Considerable care must be exercised in the work to insure as clean a casting as possible.

A large number of thin contraction webs require to be cut connecting the ribs with the sides of the channel section and at all points where they will assist in preventing fracture during the time of solidification. The drawbacks being of convenient size can be removed to an oven for drying, the rest of the mold being dried in place. The brickwork surrounding the mold is an advantage after the job has been dried since it prevents the moisture being absorbed from the surrounding floor sand to any considerable extent. The cores required for this mold are the simple straight cores for the gudgeon pins and the wedge pieces for separating the drawbacks, the latter require to be shaped so that they will follow the heavy lines shown in Fig. 11 and conform with the joint for the cope. The wood wedges used in preparing the mold are usually used to form these cores. The mold drawbacks and cores after being painted where the metal is to come in contact with them are again thoroughly dried before fitting.

An illustration of the mold having some of the drawbacks in position is shown on Fig. 11. Sectional elevations are shown in Figs. 12 and 13, illustrating the relative positions of the drawbacks with the mold. When the work is satisfactorily fitted together, and the wedge cores lowered into their respective places, the cope flasks can be replaced and the usual arrangements made for runners and risers. When the head troughs or basins are grouted to the cope and the boxes weighted the mold is ready for casting.

In all castings of this character the easing is of vital importance. All risers must be well cleared and the wedge pieces withdrawn if possible before the removal of the cope flasks so that the drawbacks may move along with the casting to a certain extent and relieve the strain at important points. Lengths of chain, rammed into the sand at critical places and carried to convenient points where they can be pulled out with a crane, are invaluable for weakening the sand. Such a method could be

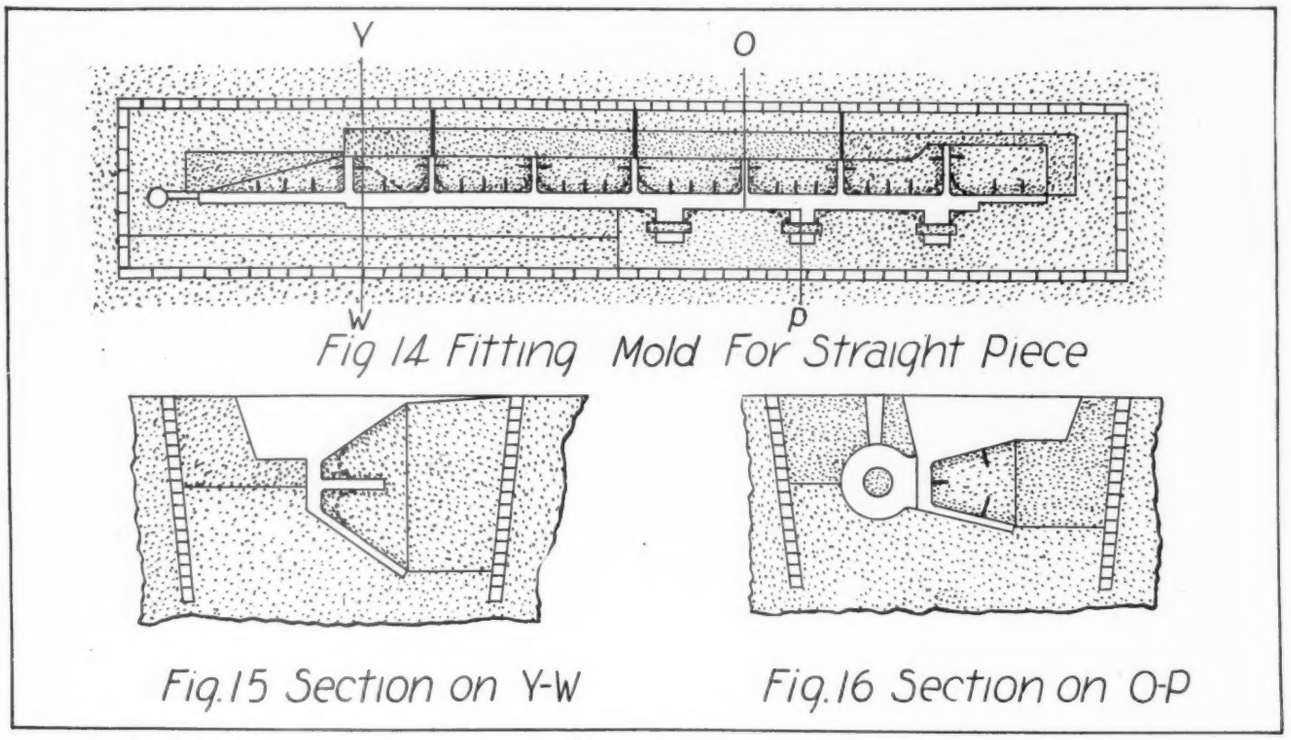


FIG. 14—FINISHED MOLD PARTLY ASSEMBLED FOR STRAIGHT PIECE FIG. 15—SECTION AT *Y W* FIG. 16—SECTION AT *O P*

adopted between the projections for the gudgeon pins.

The same method is adopted for preparing the mold for the other section of the frame. The channel section is almost parallel in this instance, hence the removal of the wedge pieces allows the inner drawbacks to be carried along with the casting while the metal is contracting, relieving it of much of the strain when taking its final shape. A plan of the mold partly closed is shown in Fig. 14. The lines of the joints and two sectional elevations are depicted in Figs. 15 and 16. These show the relative positions of the drawbacks in the mold. The cope flasks, which may number two or three, are comparatively narrow in this case and when the castings are molded in the manner indicated previously, take up less room on the foundry floor than when no brickwork is used to form a pit. The same precautions used to ease the first casting must be observed with this one, and both castings require to be annealed. Different opinions prevail respecting the best time for removing castings to the annealing ovens. Some foundrymen say the casting should be allowed to become quite cold before it is moved from its mold. Others believe that it should be put into the oven as soon after the metal is poured as is consistent with safety and while the casting retains considerable of its original heat. It is our experience that the majority of steel castings can be moved while they are hot. No ill effect will follow and fuel consumption is reduced, provided the temperature of the oven is about the same as the castings and ordinary precautions are taken while they are being moved from the floor to the oven.

Authors Outline Technique of Ship Castings Art

THIS article concludes the series on the general practice adopted in patternmaking and molding steel ship castings. Differences of opinion exist among foundrymen respecting the best procedure for the varying types of work. Different countries have different methods in applying the principles involved in securing sound castings, and it is rarely indeed that any two foundries even in the same country adopt exactly similar methods. No foundry has a monopoly on the best ideas for turning out all kinds of perfect castings economically. One of the best means of bringing about uniformity in the preparation of molds is through the technical press, and the means employed, with special regard to ship castings practice have been considerably neglected in this respect. Circulating descriptions of methods which have proved successful tend to influence the average foundryman and incidentally increase production.

Many factors must be taken into consideration with regard to the construction of the patterns. Some foundries have plant and tackle suitable for handling pattern which nearly represent the finished casting. Others prepare special core floors to reduce the molding space and are fitted to cope with block patterns having separate cores. The local system of payment may influence the foundry executive to prefer the latter method. The work may be divided among a greater number of men and more rapid production secured. It is usual for the patternshop to prepare the patterns according to the system in vogue in the foundry likely to undertake the work. Good patterns are essential to the steel founder, as the nature of the sand forming the face of the mold does not lend itself to patching as readily as that employed in molds for cast iron. Quite apart from the fact that the steel molders require a good pattern, the nature of the castings, especially those used in connection with ship construction, make it imperative that a strong pattern be supplied, having the rigidity likely to produce a true casting.

While these articles have been mainly concerned with the construction of typical patterns and the preparation of the molds, the character and composition of the sand used and the temperature and quality of the metal when poured are of equal importance in the production of sound castings. While a good sand possessing the necessary cohesiveness and sufficiently refractory to withstand the high temperature of the metal is necessary, the human factor is equally important. Finding the best means of preparing the mold so that shrinkage and contraction difficulties are reduced to a minimum, seeing that runners and risers are provided in such a manner as experience has proved to be most successful, building up the mold for convenience in separating and reassembling before and after the pattern is removed, all have much to do with producing satisfactory castings.

Many castings are lost through lack of caution when annealing. Whether the casting to be annealed is packed in the furnace hot or cold, the temperature of the furnace should be approximately that of the work and care must be exercised in packing the casting to give the necessary support without interfering with its free movement as the temperature is increased or reduced. The furnace should be heated up gradually, the temperature and the duration of the heat depending largely upon the character of the work. If it is necessary to raise the temperature gradually, it is, if anything more essential that it should be reduced gradually.

Machine Company Resumes Old Name

The name of the Cleveland Osborn Mfg. Co. recently has been changed to the Osborn Mfg. Co. When the Osborn Mfg. Co., Cleveland, established a New York branch several years ago it was unable to establish the company in New York state under the original name, because of a previously organized New York corporation having the same name. Therefore it was called the Cleveland Osborn Co. Later the Ohio charter was amended to take the same name. The company recently has acquired the charter of the New York corporation and arranged to have the business restored to its former name by which it had been known since 1892. The capital stock of the company was increased to $2,000,000 and the capacity of the plant doubled in 1919.

Besides the main office and factory situated at 5401 Hamilton avenue, Cleveland, the company maintains offices and warehouses in New York, Detroit, San Francisco, Milwaukee and Chicago. The company's molding machines are handled in France and Italy by the Allied Machinery Co., of America; in Belgium by Isbecque & Co.; and in England by J. W. Jackman & Co.

Ohio Company Starts Steel Foundry

Castings Will be Furnished to Enable the Parent Company to Build Rolling Mill Equipment—Open-Hearth Situated at One End of the Main Bay Facilitates Straight-Line Production

BEFORE starting a new enterprise or extending an established one, a comprehensive study usually is made in order to analyze the various factors bearing on the problem. Data secured in this manner are used as a premise upon which to base estimates of probable future needs. Considering the present abnormal cost of materials and labor for construction, the future must appear unusually bright to the manufacturer who contemplates increased plant capacity or facilities at this time. This is true to even a greater degree when a new field of business is entered or a new product is to be manufactured.

That the reward for enterprise apparently far more than compensates for the high cost and unusual difficulties of present day construction is well emphasized by the number of conservative firms which recently have constructed plant additions or are contemplating expansion of existing facilities. One of these is the Alliance Machine Co., Alliance, O., which about a year ago, decided to increase its facilities so that it would be in a position to compete for orders for rolling mill equipment. A rolling mill department was organized with C. N. Resse as engineer in charge of rolling mill design. One of the first questions to arise was that of providing an adequate supply of steel castings and in order to solve this problem the Machined Steel Castings Co. was formed. The company not only will make all the steel castings for the Alliance Machine Co., but also will do a general jobbing business. The latter company also is closely affiliated with the Alliance Structural Co. which is engaged in erecting work. The close relations existing between the three associated companies affords the Alliance Machine Co. an unusually good opportunity to produce rolling mill equipment.

Work on the main building of the Machined Steel Castings Co. was started June 16, 1919, and the first heat was poured Dec. 24. The plant is situated on a 17-acre plot of land on the east side of Mahoning avenue, Alliance, which divides Stark and Mahoning counties, the works being

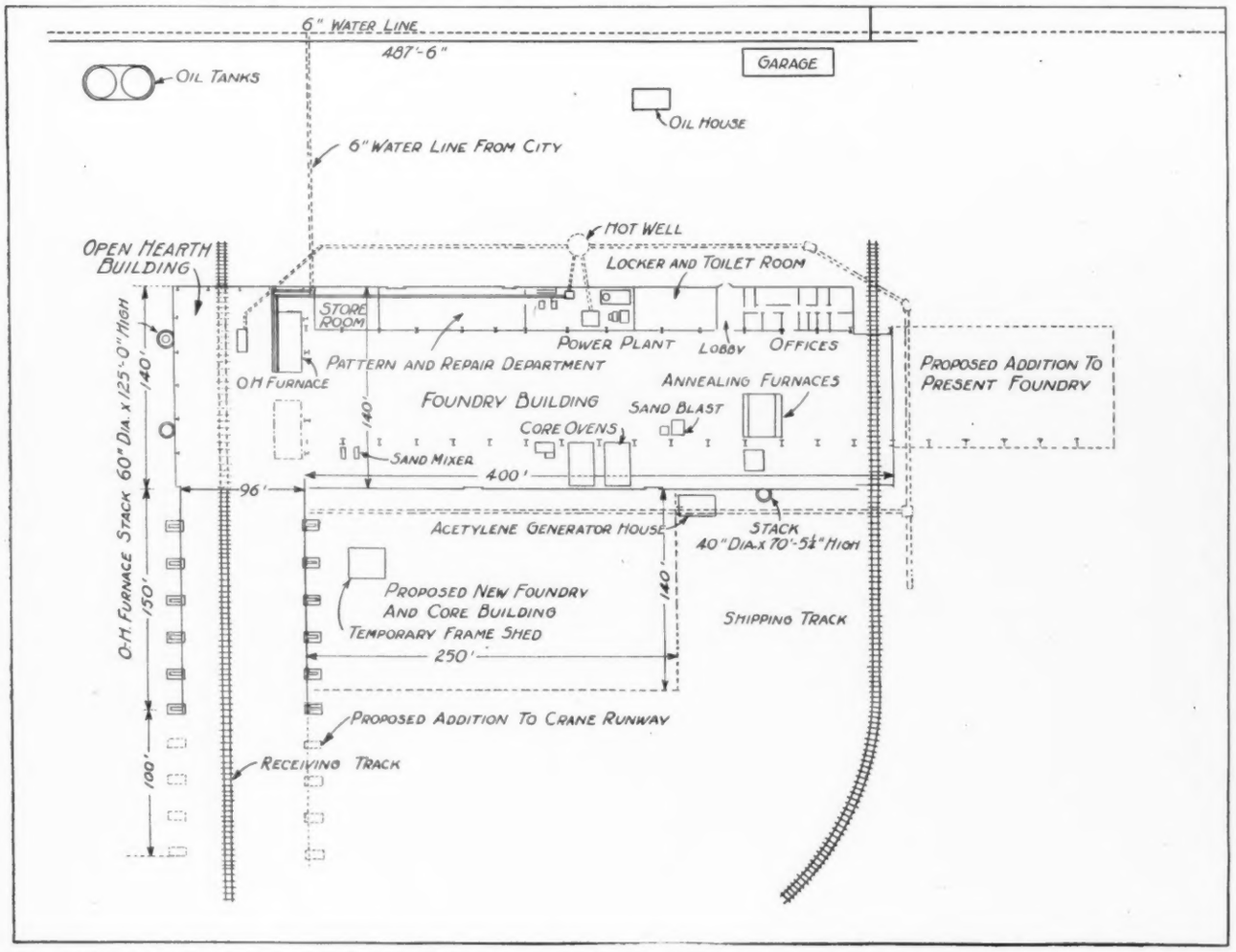


FIG. 1—MATERIALS ARE BROUGHT TO THE OPEN-HEARTH FURNACE FROM THE STOCK YARD AT THE ONE END AFTER GOING THROUGH THE FURNACE THE STEEL IS POURED INTO MOLDS ON THE FLOOR FROM WHENCE IT TRAVELS ALONG A STRAIGHT LINE PAST THE CLEANING AND ANNEALING DEPARTMENTS TO THE SHIPPING TRACK

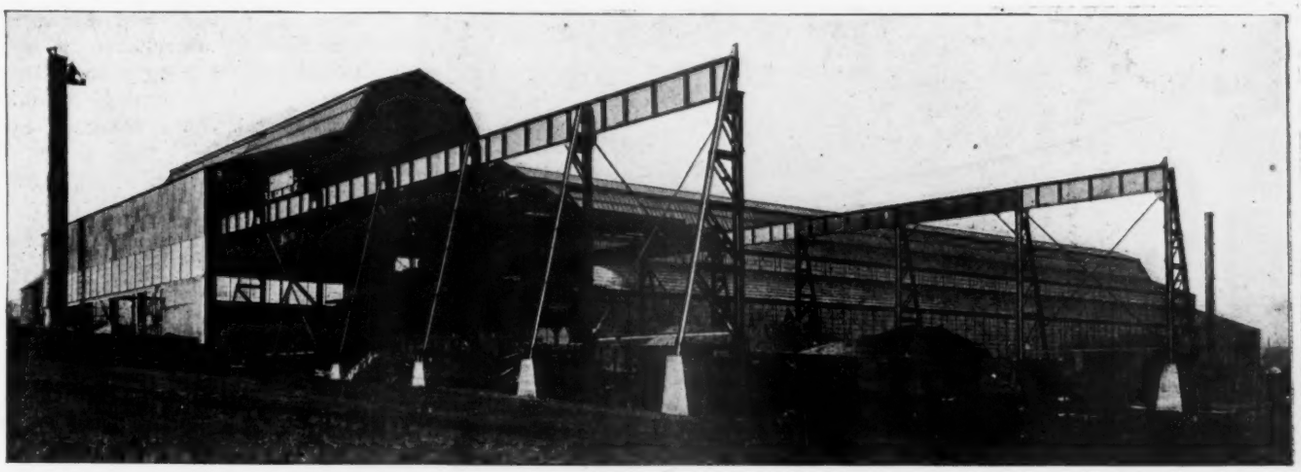


FIG. 2—THE STOCK BAY LIES AT RIGHT ANGLES TO THE MOLDING FLOOR—PIG IRON AND SCRAP STEEL ARE BROUGHT TO THE CHARGING PLATFORM BY THE YARD CRANE WHICH TRAVELS IN FRONT OF THE FURNACES

in Mahoning county outside of the city limits. The plant is served by railroad sidings connecting with the Cleveland and Pittsburgh branch of the Pennsylvania railroad. Much of the acreage is low and will afford ample dumping ground for many years.

As shown in Fig. 1, one of the railroad spurs extends through the stockyard to the charging platform of the open-hearth department. The yard is commanded by a 15-ton crane running on a 90-foot runway extending across the charging floor. By the use of magnets and grab buckets the crane unloads pig iron and scrap and carries them in standard shaped charging buckets to the charging floor where they are set on flat bottomed cars on the track paralleling the front of the furnace. Sand also is handled by this crane. A general exterior view of the building showing the crane runway and the stockyard is shown in Fig. 2.

The acid-lined 25-ton open-hearth furnace, shown in Fig. 3, was designed and built by the company. The doors and front plates are water cooled so that they will not buckle from the heat within.

As a means of contributing to the comfort of the workmen the sash in the wall of the building at the rear of the furnace are removable. These sash, together with those between the charging floor and stock bay, are removed during the summer months to allow air to circulate freely, over the platform and through the monitor in the roof.

The materials are charged into the furnace by a 5-ton charging machine, shown in Fig. 3, which was built by the Alliance Machine Co. This machine moves along the tracks as shown in the illustration and pushes the cars with the charge boxes by engaging them with the head of its ram. The furnace doors are controlled by means of large hand wheels shown in Fig. 3, which are geared low and can be handled without difficulty by one man. The valves also are operated from the same point.

In charging the furnaces a small

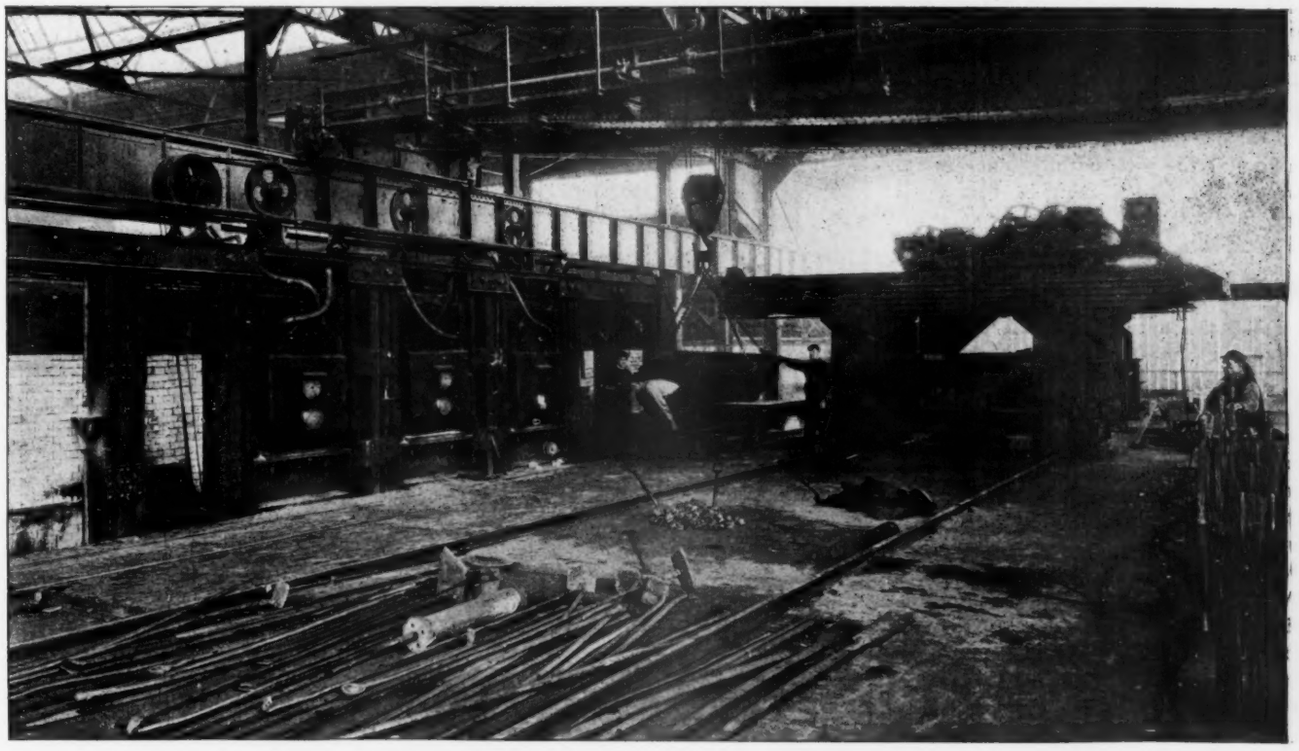


FIG. 3—SECURITY AGAINST BUCKLING IS PROVIDED BY WATER COOLING BOTH THE DOORS AND THE FRONT PLATES OF THE FURNACE—MANGANESE IS ADDED TO THE STEEL IN THE FURNACE INSTEAD OF IN THE LADLE

FIG. 4—FROM THE PLATFORM IN FRONT OF THE OPEN-HEARTH DEPARTMENT WORK IN THE ENTIRE FOUNDRY MAY BE SEEN—NOTE THE TWO SIDE BAYS

amount of scrap is placed on the bottom, after which the pig iron is charged and the remainder of the scrap is added. When these materials have been melted the carbon content of the mass is reduced to the proper amount by adding iron ore. After the boil is finished and the carbon content is shown by fracture test to be sufficiently low, 10 per cent ferrosilicon is added. A quantity of this material is shown at the right in Fig. 3. The ferrosilicon is placed directly inside of the three charging doors by the use of a peel. The doors then are closed until the pig has a chance to heat after which they are again raised and the metal is pushed into the bath. The ferromanganese, also shown in Fig. 3, is thrown into the furnace through all three of the doors. The bath is then stirred with long steel bars extending through the peep holes of the doors. A small amount of manganese is also added in the ladle as the heat is tapped, but this addition is only a fraction of the amount used in the furnace. Additions are made in the furnace because it is thought that the manganese mixes more uniformly with the steel, but there is a greater loss of the alloy than when it is added in the ladle.

When the metal is tapped into the ladle it is carried by crane to the molding floors in the main bay. This part of the building is 400 feet long and has a runway 75 feet wide. Practically all of the foundry work is performed in this bay. At present two cranes are operating in this section of the building. One is of 30-ton capacity with a 10-ton auxiliary hoist and the other is of 15-ton capacity. These, as well as all other cranes in the plant, were made by the Alliance Machine Co. As shown in Fig. 4, the main bay is flanked on either side by a 30-foot side bay, the one on the left being partitioned into various rooms and that on the right forming an extension to the main bay.

After sand is brought into the building from the stock bay it is delivered to a sand mixer of the muller type situated in the end of the side bay toward the open-hearth furnace. At present the sand is being carried in wheelbarrows but a conveying system is to be installed. The mixed sand is carried to the molding floors in boxes handled by the cranes.

The core and drying ovens are situated about half way along the side bay as indicated in Fig. 4. The ovens were built by the Ohio Blower Co., Cleveland. A novel feature of the core oven trucks is the design of the bearings. As shown in Fig. 8 each truck is supported on two axles, the wheels being shrunk onto the axles. The journals rest in U-shaped bearings which are of such dimensions that the axle is loose and moves from one side of the U to the other when the direction of the truck is changed. The core department also is in the side bay next to the mold drying ovens. This department is served by a 3-ton crane which handles sand and moves some of the larger cores.

The sand blast equipment, which is located near the shipping department, consists of a revolving barrel and a sand blasting chamber built by the Pangborn Corp., Hagerstown, Md. The installation of this equipment is shown in Fig. 7. The roof of the sand blast room has a long narrow opening, closed by a door when desired, which allows the chain of the crane to enter when large castings are being handled.

The annealing pit, shown in Fig. 6, was designed and built by the company. It is 25 feet long, 15 feet wide and 9 feet high to the base to the arch. Heat is provided by three oil

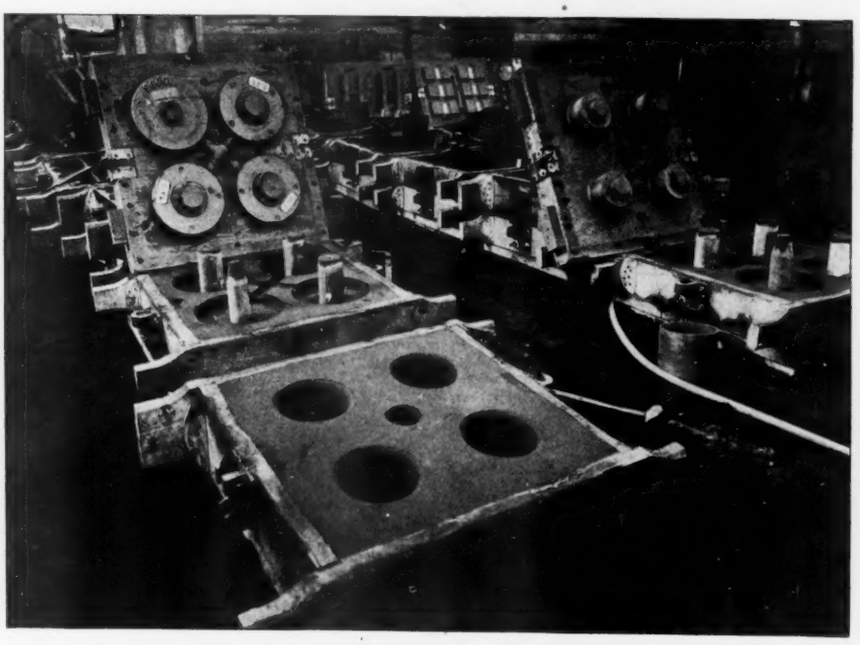


FIG. 5—SHAFT COUPLINGS ARE MADE IN GREEN SAND WITHOUT RISERS—THEY ARE CAST WITH THE FINISHED SIDE DOWN

burners on each side and near the bottom of the oven. The burners are accessible through a long narrow pit on each side. The top of the annealing pit is covered with large cast steel bungs lined with firebrick. The bungs are handled by the traveling crane and may be stacked one upon another, the projecting lugs at each corner preventing the brick work of the upper bung from touching the framework of the lower one. A furnace of this size requires a comparatively long time to heat, especially when filled to capacity with castings. In order to accommodate smaller castings and to reduce the heat required for annealing a smaller oven is being built. It is intended that this oven will be under heat practically all of the time. A charge can be quickly removed as soon as it becomes black and another charge can be put in the furnace before it becomes entirely cold. The castings will be charged through a door by means of a peel.

In past years the Alliance Machine Co. has had considerable difficulty in securing an uninterrupted supply of shaft couplings, bearings and similar small castings. Therefore, one of the first acts of the new company was to equip the foundry for making castings of these kinds. Two floors of molds for shaft couplings are shown in Fig. 5. As shown in the illustration four patterns are mounted on match boards with set gates. Two molders work in conjunction with each other, one working on the drag and the other on the cope. When each man finishes his section of the mold, the patterns are exchanged and each then puts up the other half of the molds. When it is ready to be closed the molders help each other and in this way one complete pattern serves two molders. The molds are gated from the bottom and the side of the casting which is to be machined is cast face down. This is thought to give a cleaner surface than would be obtained if it were cast face up. The molds are made in green sand and no riser is used.

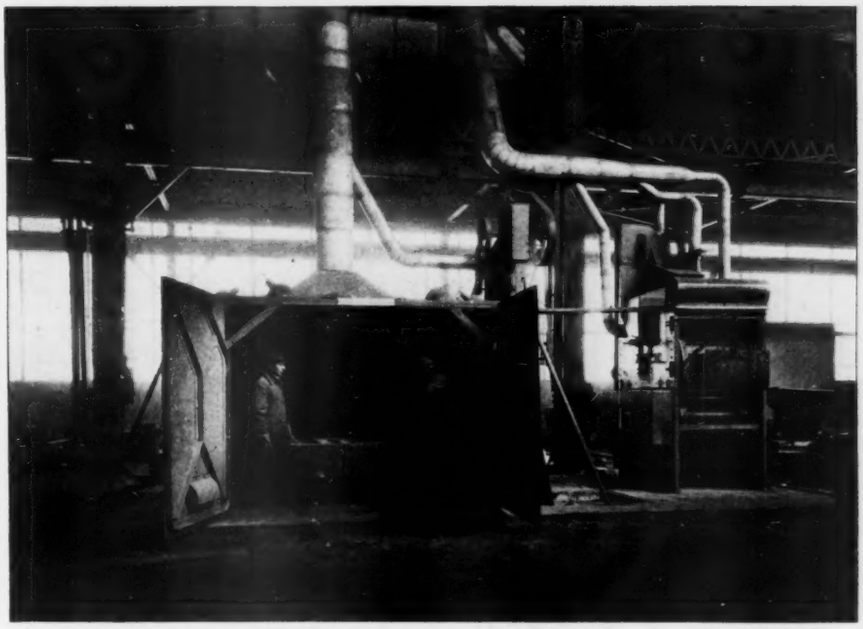


FIG. 7—CASTINGS ARE PLACED IN THE SANDBLAST ROOM BY THE CRANE—THE CHAIN FITS THROUGH AN OPENING IN THE ROOF, WHICH IS CLOSED WITH A DOOR WHEN THE SANDBLAST IS OPERATED

Pneumatic Tools Cleaned Regularly

The side bay which is partitioned off from the main bay contains a store room, pattern shop, power plant and offices. The store room is at the end near the furnaces and contains the less bulky materials and the smaller tools used in the foundry. In addition to handling these articles the stockkeeper is in charge of the pneumatic tools. Each evening all pneumatically operated tools are turned in to this department where they are thoroughly cleaned with kerosene and oiled before they are issued again.

The pattern and repair department is in a room next to the store room. Comparatively new patterns are made but considerable work is done repairing old patterns and changing equipment to suit molding condition. The power plant which is adjacent to the pattern department contains equipment for converting electricity supplied by an outside power company. Two rotary converters change alternating current at 2200 volts to 250-volt direct current for use of the crane and grinder motors after voltage has been stepped down through three transformers. Three other transformers are employed to step down the current to 440 volts at which pressure it is used on motors requiring alternating current. Still another transformer changes the voltage to 110 for the lighting system. All of the electrical equipment was furnished by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The power plant also contains an air compressor with a capacity of 1300 cubic feet per minute built by the Ingersoll-Rand Co., New York. The heating equipment, also in this department, consists of an oil fired boiler furnished by the Erie City Iron Works, Erie, Pa., and a set of steam coils across which air is blown by a fan. The heated air is carried through

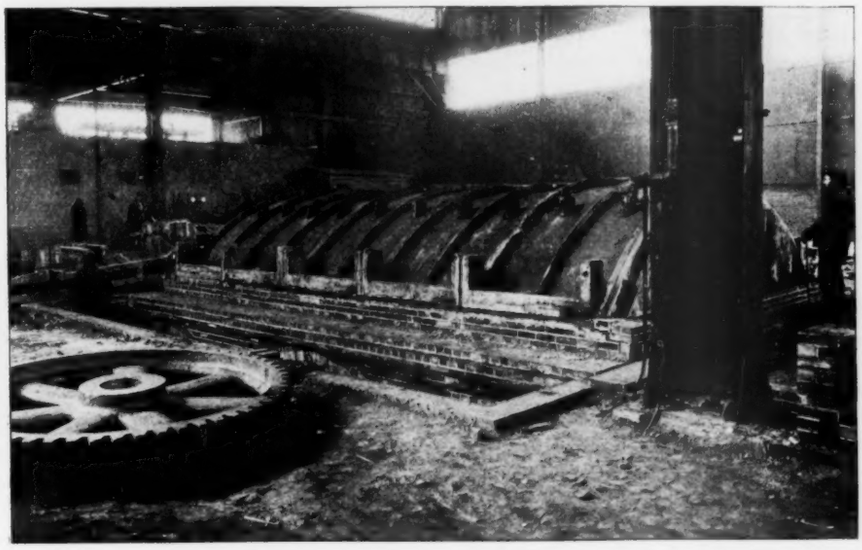


FIG. 6—OIL-FIRED ANNEALING PITS OF THE BUNG TYPE ARE USED—THE BURNERS ARE REACHED THROUGH A LONG NARROW PIT ON EACH SIDE OF THE OVEN

ducts into all parts of the foundry and discharges through pipes about 2 feet from the floor level. The ends of the pipe are covered with a distributor which causes the discharged air to spread out horizontally in a circle.

Part of the water supply, which is secured from the city mains, is used in the open-hearth furnaces for cooling purposes. Water from the furnace goes to the hot well, indicated in Fig. 1, from where a portion of it returns to mix with fresh water entering the open hearth. Fresh water also is used to cool the air compressor and is then sent to the hot well. The heated water from the hot well is injected into the steam boiler of the heating equipment thus saving the fuel which otherwise would be required to heat cold water as taken from the main.

The remaining space in the side bay is devoted to offices and locker and toilet rooms separated by a lobby in which the time clocks are located. Individual lockers have been provided for each workman so that he may have a place to keep clothing and personal belongings where it will be secure from interference.

A small brick structure outside of the main building has been erected for housing an acetylene generator and for storing oxygen tanks. Considerable acetylene and oxygen is used in the cleaning room for cutting the risers and heads from castings. In order to insure a continuous supply the acetylene is generated and a quantity of it stored while the oxygen is kept in the small tanks in which it is received. In order that the gas may be used uninterruptedly a special pipe system was installed. Twenty oxygen tanks are attached to the main supply pipe, which is divided into two compartments, 10 tanks being connected to each compartment. This arrangement making it possible to supply oxygen from one side while 10 fresh tanks are being coupled to the other side of the supply pipe. The acetylene equipment was supplied by the Davis-Bournonville Co., Jersey City, N. J. The welding equipment also includes an electric set manufactured by the Westinghouse Electric & Mfg. Co.

Fuel oil is stored outside of the main building in two underground 50,000-gallon tanks. Other oils, including kerosene and lubricating oil, are stored in a separate brick building, indicated in Fig. 1.

The capacity of the present equipment already has proved inadequate and a second 25-ton open-hearth furnace is being installed. A 30-ton and a 15-ton crane also have been ordered and will be erected in the main bay. The added furnace and crane facilities will enable the company to pour 60 tons of metal into one mold as each of the furnaces has enough capacity over the rated amount to enable each to melt 30 tons at a heat. The foundry now is engaged on an order for more than a million pounds of castings to be used in the construction of the sheet rolling mills which the Alliance Machine Co. is building for the plant for the Republic Iron & Steel Co., at Niles, O. This order requires 32 housings each of which weighs 34,000 pounds.

When the two open-hearth furnaces are working at capacity more foundry space will be required and this will be secured by extending the stockyard crane runway 100 feet, building a 140 x 250-foot addition at the side as indicated in Fig. 1, and extending the end of the foundry 150 feet, thus increasing the cleaning room space. When these additions are made the new bay will be used as a molding floor and the molds will pass through the drying ovens to the main bay, where they will be poured. At present only one shift of molders are working but it is intended to work two 8-hour shifts and to run the furnaces continuously.

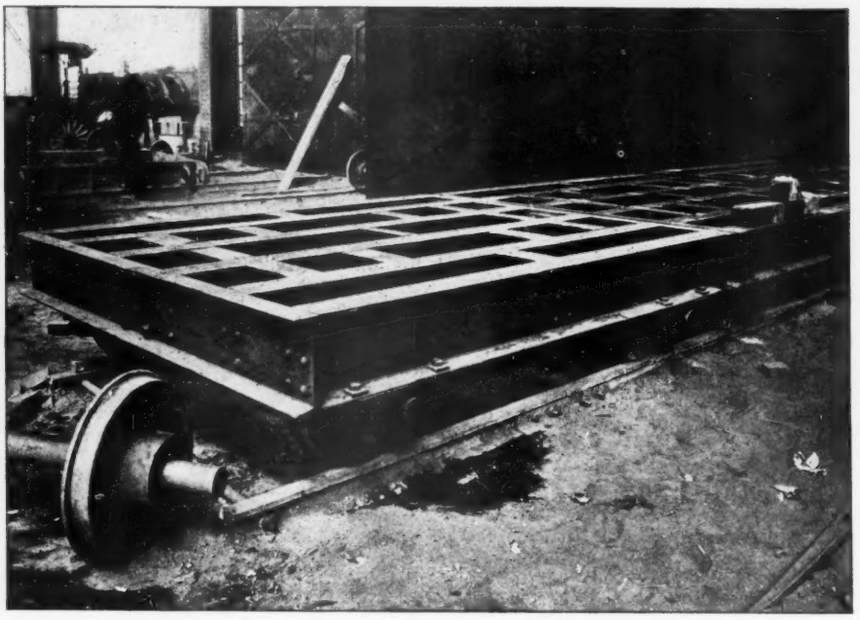


FIG. 8—A SLIDING BEARING ON THE DRYING-OVEN CARS IS AFFECTED BUT LITTLE BY THE HEAT—THE WHEELS ARE SHRUNK ON THE AXLE

Melting Iron With Powdered Coal

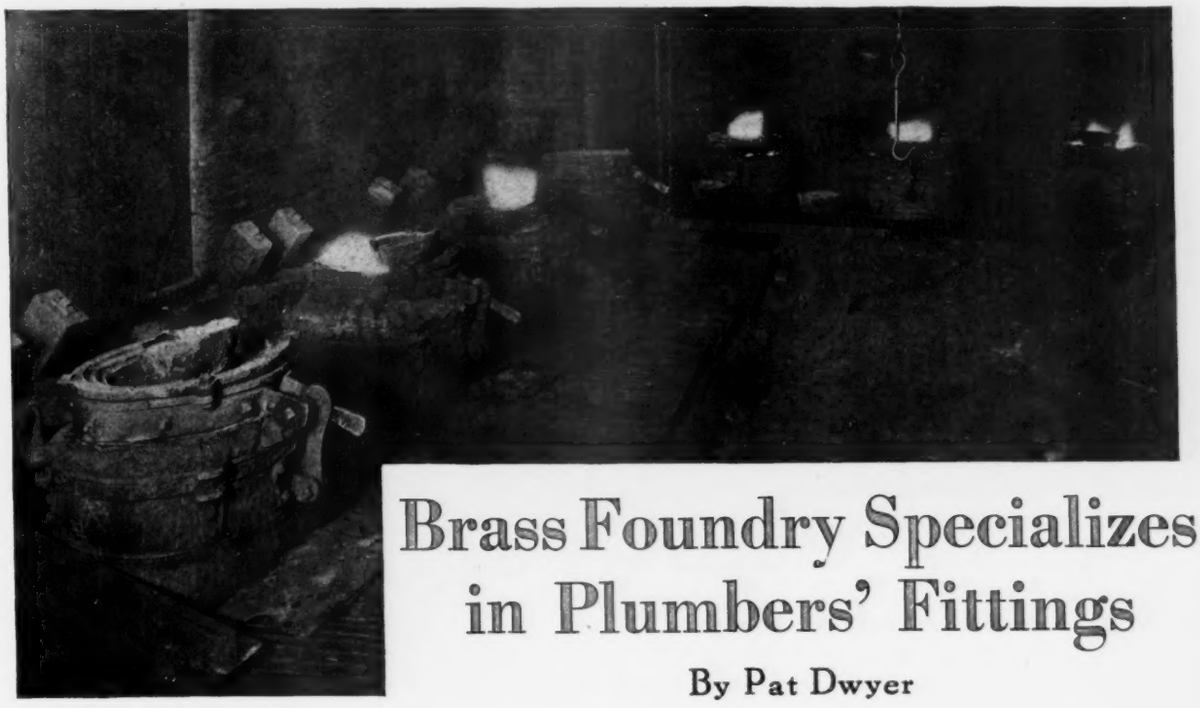
(*Concluded from page* 139)

separator to remove all metallic particles and dropped into a rotary kiln dryer. The inverted cone shown connected to the upper end of the dryer is a dust arrester which retains and separates the coal particles from the dust which is given off in the dryer. At the lower end of the dryer is an elevator which carries the dried coal upward and delivers it through a chute into the dry storage hopper. From this hopper it is fed into the pulverizer, from whence it is carried upward by air pressure and delivered through a second arrester to the storage hopper or tank. From this point the material is forced under air pressure to the supply hopper at the furnace much in the same manner as water is forced through delivery mains.

Company Desires Data

Fundicion y Talleres "La Union," 4056 Calle Corrientes, Buenos Aires, Argentina, South America, is constructing a new iron foundry, 120 x 200 feet, and also plans to extend its brass foundry. The company wishes to receive catalogs covering all classes of foundry equipment, and especially molding machines for light work.

The Ideal Furnace Co., main office Detroit, which has for years operated a furnace and boiler shop in Milan, Mich., has purchased the plant and foundry recently vacated by the Homer Furnace Co., Homer, Mich. The latter company has moved into a large new plant at Coldwater, Mich.



Brass Foundry Specializes in Plumbers' Fittings

By Pat Dwyer

WATER for internal and external use is one of the prime requisites for the maintenance of life. Seven-tenths of the human body is composed of water and owing to the changes and elimination constantly going on the supply must be replenished regularly. Under primitive conditions, a running stream or a pool of water were ample and fulfilled all requirements. However, where large numbers of people lived in the same community, these primitive facilities were totally inadequate and other systems had to be devised to supply sufficient water for household purposes. In the original community installations, stone aqueducts and hollow logs were employed to convey the water from its source of supply to where it was used. The baths of the ancient Romans were elaborate, but there is no evidence extant to show that they had showers or any way to supply hot and cold water by turning a tap. All primitive methods of supplying water naturally were wasteful and therefore as the problems of supplying towns and cities with water gradually developed, it was realized that a much smaller initial supply would suffice if some means of regulating its use could be devised. Then if only enough was used to supply the actual needs of the people, the remainder could be conserved and held in reserve, instead of being allowed to go to waste. Problems thus introduced have served to build up large industries devoted to the production of devices for checking and controlling the flow of water. The largest of these are made of iron or steel, but practically all the small fittings for this purpose are made of red brass.

Among the firms engaged in this line of work is the Glauber Brass Mfg. Co., Cleveland, which produces a complete line of plumbers' brass castings. Over 10,000 separate patterns are in use in its foundry or stored in its pattern vaults. Nearly every conceivable size and type of brass water connection, from the brass screw in the service connection in the street main line, to the last valve leading to the waste pipe are made in its shops.

Operations Compactly Grouped

Every operation in connection with manufacturing the fittings is carried on in the one group of buildings. The metal is melted, molds made, castings poured, cleaned, machined, buffed, polished, nickel plated, assembled and shipped all in one plant. The company maintains a high standard for all its work and furnishes a five-year guarantee with all of its products against defect or deterioration. When it is realized that many of these castings are in constant use all day opening and closing and under constant water pressure, of from 50 to 70 pounds, it is apparent that the metal must be of a superior character and the parts fitted with the greatest degree of care and accuracy.

The metal is melted in a battery of seven oil-fired pit furnaces in a room 20 x 40 feet, partitioned off from the other departments. In addition to the furnaces, the room contains a chamber 6 x 8 x 12 feet lined with shelves on both sides, having a capacity of 100 crucibles. This chamber is kept heated constantly by a steam coil, to eliminate any possibility of the crucibles absorbing moisture from the atmosphere. Before the war some economical measures tending to prolong the life of crucibles were observed, but at the present time when the cost of crucibles has trebled and the cost of fuel quadrupled, such measures are a positive necessity. The roof of this room is 30 feet from the floor and is provided with a row of pivoted windows extending the full length of both sides to afford ventilation. A 40-inch suction fan situated in each of the gable ends of the roof serves also to draw the fumes and smoke from the furnace room. A light traveling crane spans the room from side to side and is provided with an air hoist having a capacity of 500 pounds. This is used for drawing the full pots out of the furnace. The air hose supplying the hoist is led from the floor up through a chamber alongside the door between the furnace room and the molding room. It passes over a sheave wheel located just under the crane rail. It pays out, or runs back over the sheave as the crane is pulled back or forth and in this way there is no slack hose hanging down to interfere with the work of the hoist or in any danger of being burned with the red hot pots. The bridge of the crane consists of a single section of an 8-inch I-beam. A similar beam is suspended from the roof of the molding shop at

FIG. 1—ONE OF THE GANGWAYS SHOWING THE POURING STANDS—INSTEAD OF USING SLIP JACKETS, NARROW IRON BANDS ARE USED TO EMBRACE THE MOLDS AT THE JOINTS

the same height from the floor as the crane beam. This extension beam commences at the doorway connecting the furnace room and molding shop, and extends into the latter for a distance of 40 feet.

When a pot of molten brass is ready the furnace tender blows a whistle operated by compressed air and two foundry helpers repair to his assistance. The furnace man shuts off the oil, throws back the cover of the furnace and attaches the lifting tongs to the pot. One of the laborers pulls on an endless chain which operates the traveling mechanism of the hoist and brings the crane into position over the furnace where the hook engages the link of the tongs. The other laborer operates the valve which hoists the pot out of the furnace. The crane is then propelled back until the beam forming the bridge is in line with the beam extending into the molding shop. A safty catch worked by a chain from the floor is thrown into position locking the ends of the beam into a straight line and then the pot hanging from the trolley is pushed out through the doorway until it reaches the end of the beam. Here it is lowered off into a double shank resting on the floor. Any further additions to the metal are made at this stage. If the metal is too hot, one or more scrap gates are added to cool the crucible contents to the proper temperature.

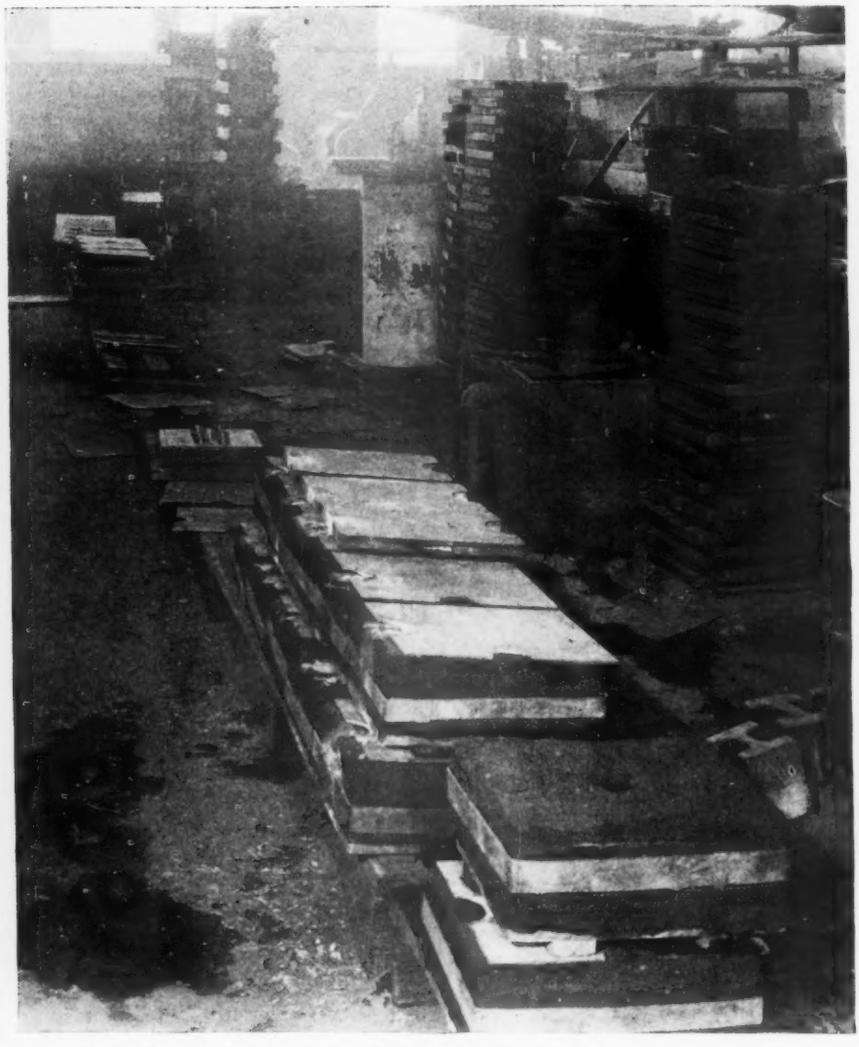


FIG. 2—METHOD OF STACKING THE MOLDS FOR POURING—ALL THE PATTERNS ARE ARRANGED IN GATES TO BE POURED FROM ONE END OR ONE SIDE

Several mixtures of metal are melted every day to meet the diversified character of the work on the floor. A mixture used for the castings which have to stand the most severe service is made up of 80 and three fives; that is 80 per cent copper with 5 per cent each of lead, tin and zinc. The charge consists of approximately half and half virgin metal and scrap. Most of the scrap consists of sprues, and runners, defective castings, and turnings from the machine shop. In charging the pots which are all of a uniform size, No. 70, a large shovelful of turnings is put in first, then the new metal is added and then the scrap which is fed in constantly until the pots are full. A limited amount of foreign scrap is used but it is all

carefully graded and each kind kept in separate barrels provided for that purpose.

Each furnace is capable of melting about 6 pots a day. The first pot starting on a cold furnace requires about 1½ hours to melt, but after that the time averages about ¾ hour for each. The pots hold about 250 pounds, so the total daily capacity is between 5 and 6 tons. This would not mean so much if distributed among heavy castings but when it is used to pour castings some of which only weigh a few ounces the total quantity is enormous.

Judging the Metal Condition

The melter does not depend upon a pyrometer to gage the heat of the metal. By inserting a rod in the pot after his eye tells him it is about the proper temperature he can tell whether it is hot enough or not. When molten brass in the pot reaches the casting temperature, it imparts a vibration to the iron rod and the man holding the other end of the rod in his hand can judge the temperature by the character of the vibrations. The foreman examines each pot when it is lowered from the crane decides what additions if any are necessary to bring it to the proper pouring temperature and composition. He then sees that it is skimmed and tells the men where to carry it. Upon reaching the designated floor the molder working there takes the double end of the shank and pours his own work. Some of this work can be poured by ordinary labor but most of it requires a quick tip when starting and a quick cut at the end, a trick which only can be acquired through practice.

A plan of the foundry floor, which is 63 x 95 feet, is shown in Fig. 8. The floors are arranged in four groups. Two groups back to back along the center of the shop and the other two groups close to the side walls. Two wide concrete gangways parallel to the side walls are situated so that each gangway serves two groups of floors, one to either side as shown in Fig. 8.

A fine grade of sand is used for both molds and cores. Supplies are received from Ohio, Kentucky and Illinois sand beds and mixed in varying proportions for each class of work. The molds are all made on squeezer machines. The machines along both walls are plain hand squeezers while those on the floors back to back in the center of the shop are power squeezers made by the Tabor Mfg. Co., Philadelphia. The molds are carried from the machines and stacked two deep on frames made of two pieces of 2 x 4 lumber laid on each side of the gangway. The frames are mounted on 6-inch blocks, the object being to raise the runners a sufficient distance from the floor so that when the lip of the full crucible is brought close to the sprues the bottom will be clear of the floor. This further assists in pouring as the men do not have to bend so low. The more a man has to stoop, the greater difficulty he has in manipulating the shank.

Each man sets a row of about 10 molds on a frame in front of the floor,

FIG. 3—DETAIL OF TONGS—NO LINK IS USED ON THE TOP—THE LIFTING HOOK EXERCISES SUFFICIENT TENSION TO HOLD THE POT FIRMLY

he then lays a thin flat plate on each one and a second row of molds is piled on top of the first. The top row is kept back about 3 inches to leave the runners in the lower row exposed. Flat plates are then set on the top row and a small weight placed on each mold. The bottom row of molds is poured first. This is done to guard against the possibility of metal splashing the runners while pouring the top row.

The molds are shaken out immediately after the last one has been poured. The castings picked up immediately by a pair of tongs and plunged into a tank of water. This treatment serves to clean them both inside and out. The steam generated blows the cores out and leaves the castings perfectly clean on the inside. Pouring goes on continuously all day.

The molders put up from 70 to 100 flasks a day but the floors are comparatively short because the molds are poured on each floor before more than 20 have accumulated. All the drippings, spills, overflows and skimmings are passed through a wet mill and the metal recovered. The return scrap from the finishing shop together with bearings and chips are passed through a Dings magnetic separator to remove any particles of iron or steel.

Cores are used so extensively in plumbers' fittings that there are practically as many coremakers as molders employed. Owing to the light section of metal the cores must be extremely accurate. This is accomplished by pasting them while green and drying them in dryers which hold them in shape and prevent distortion. The work in the core room is systematized and results in the production of from 300 to 400 cores by each coremaker per day. The coremakers sit or stand at two benches and do nothing but ram the cores and set them on plates. A helper keeps them supplied with sand, wire, paste and plates, and carries filled plates to the ovens. The latter, three in number, are the plain drawer shelf type fired by either oil or gas depending upon which is the more readily available. The gas and oil supply pipes terminate in the same burners and a switch can be made from one to the other at a moment's notice.

Preparing Wires in Quantity

One girl cuts all the wires required for the cores on a wire cutting and straightening machine and bends those which have to be bent on a cast iron plate 2 x 12 x 14 inches. This plate is perfectly flat on top and is provided with ¼-inch holes set close together over the entire surface. Plugs and stops are inserted in the necessary holes and the wires are bent around them to the required shape. By varying the position of the plugs, any desired shape of wire may be secured. Two half coreboxes are provided for each size of core. The sand is pressed into each half by hand, the necessary wires pressed into what will be the lower half, vent wires set, paste applied, and then one box is superimposed on the other, being located by suitable pins. The vent wires are withdrawn, the top box rapped and removed and replaced by a dryer frame.

FIG. 4—ABOVE—THOUGH APPARENTLY VERY DELICATE, THE CORES ARE REALLY SUBSTANTIAL—THOSE ON THE LOWER RIGHT HAND PLATE ARE DRIED AS THEY STAND WITHOUT DRYERS FIG. 5—AT THE LEFT—THE PATTERNS ARE MOUNTED ON FOLLOW BOARDS MADE OF A COMBINATION OF LINSEED OIL AND SAND FIG. 6—BELOW—TYPICAL CORES FOR PLUMBERS' GOODS—THEY ARE MADE FROM AN OPEN FREE-VENTING FINE GRADE OF SAND—NOTE THE SYMMETRICAL SHAPE

The box is then turned over rapped and the other half of the core box removed. The core resting on the drier is placed on a plate and when the plate is filled it is taken to the oven. When the cores are taken from the ovens they are inspected by experienced men who reject any that may be defective. Minor defects are repaired and then the cores are placed on the racks ready for the molders.

Cleaning the Castings

The castings are cleaned by sandblasting, in a combined sandblast and tumbling barrel after which they are inspected, ground and polished. They are then taken to the machine shop where they are fitted and assembled after which they are tested individually for leaks or other imperfections. A complete nickel plating plant is maintained on the premises and any of the castings which are to be finished in that manner are passed through it and treated.

The company designs, makes and finishes its own patterns, coreboxes and dryers. All the parts are made of brass and highly finished. The core dryers and coreboxes are stored in bins and racks at one end of the shop while the patterns, which are all mounted on follow boards are kept, some in storage vaults and some on shelves on a balcony running the full length of the shop on one side. Part of this system of shelves is shown on the extreme right on Fig. 3. The patterns are all numbered and indexed to make them readily available when wanted.

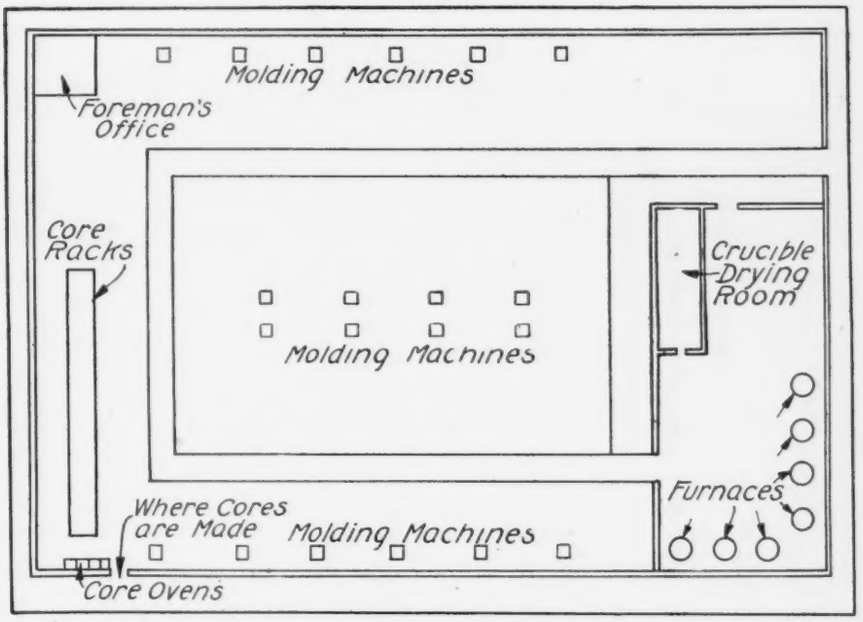


FIG. 8—LAYOUT SHOWING THE ARRANGEMENT OF GANGWAYS AND POURING FLOORS AND THE SEPARATE FURNACE ROOM

Oppose Metric System

In a new edition of the book entitled "The Metric Fallacy," the author, Frederick A. Halsey, commissioner of the American Institute of Weights and Measures, outlines the results of an investigation of the claims made for- the- metric system and especially of the claim that its adoption is necessary in the interest of the export trade. Chapter I is devoted to a brief history of the metric system in France. Metric standards were made compulsory by a drastic law in 1793 and remained in force 19 years or until 1812 when Napoleon, who had no faith in the system, had the law repealed. Under the relaxed laws, the people immediately reverted to the universal system in which 12 inches makes a foot, and continued the practice for 25 years or until 1837 when the metric enforcement laws were reimposed, continuing in effect until the present day.

In Chapter II, the replies to 500 questionnaires distributed in South and Central America and the West Indies indicate that the metric system is not used extensively in Latin America. The results of the questionnaires are tabulated in the back of the book. In but one country, Uruguay, can the metric system be said to be adopted for domestic trade and from this country answers were received to the effect that while the metric system was official, the English system was customary and no effort has been made to abolish it.

Another chapter is devoted to arguments against the claim that the metric system is necessary in the interest of foreign trade. A summary of the replies to questionnaires submitted to American exporters shows that of 1445 replies, 1189 did not use the metric system; 160 used is slightly; 29 used is considerably; 16 used it extensively; 5 used it exclusively and 46 did not reply. One manufacturer reports that 95 to 100 per cent of his tools shipped to South America are made to English unit specifications. Referring to engineering standards, it is stated that the compulsory adoption would mean revision in every industry.

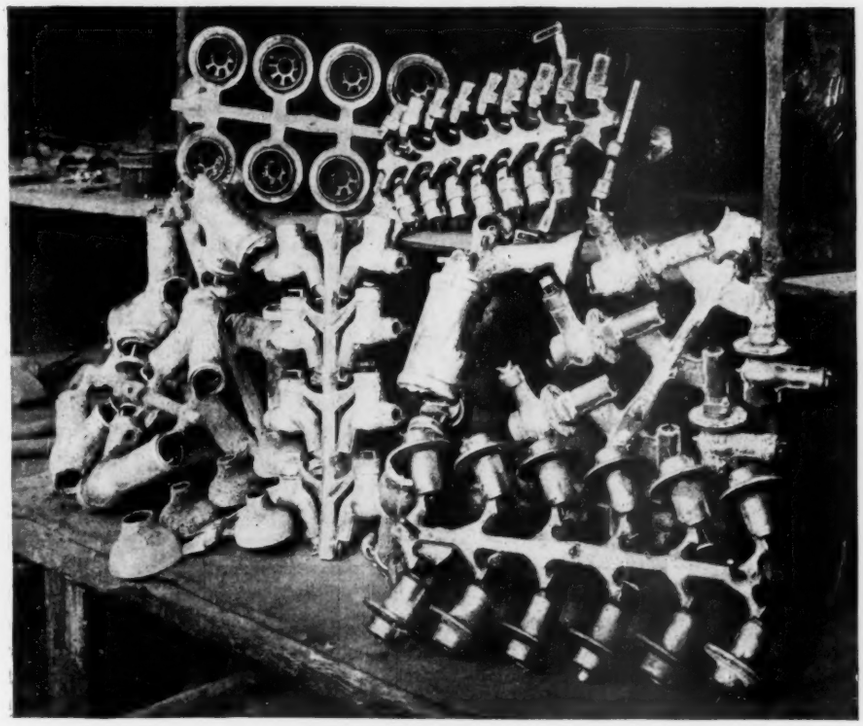


FIG. 7—A GROUP OF TYPICAL CASTINGS WHICH HAVE BEEN JUST SHAKEN OUT—NOTE THE CLEAN SURFACE, METHOD OF GATING AND ALMOST ENTIRE ABSENCE OF FINS

How and Why in Brass Founding

By Charles Vickers

Aluminum Specifications

We have been called upon to produce aluminum castings conforming to the following analysis and we have had considerable trouble in meeting the specifications in regard to elongation. The specifications for composition are: Aluminum, not under 94 per cent; copper, not over 6 per cent; manganese, not over 2 per cent; iron, not over 0.5 per cent. The physical properties demanded are: Tensile strength, minimum, 18,000 pounds per square inch. Elongation in 2 inches, minimum, 8 per cent. We shall appreciate any suggestions you may have to offer.

In a paper on Aluminum Castings and Forgings, presented before the American Institute of Metals, and embodied in the Transactions of the Institute for 1916, P. E. McKinney gives tests of sand cast bars of an aluminum alloy which meets the requirements mentioned. The alloy consisted of aluminum, 96 per cent; copper, 2 per cent, and manganese, 1.50 per cent. A series of 11 tensile tests were made the average tensile strength being over 20,500 pounds per square inch, and the average elongation being over 12 per cent. We would suggest, therefore, the above alloy be used as in none of the 11 tests did the elongation go below 8 per cent, or the tensile below 18,000 pounds per square inch.

Soldering Aluminum

We would like to learn if the following solders are suitable for soldering aluminum: Aluminum, 20 parts; zinc, 80 parts. The aluminum is melted first then the zinc is added gradually, and when all is down a flux of fat is stirred in with an iron rod. The alloy is then ingoted. It is used in connection with a flux consisting of copiaba balsam, 3 parts; venetian turpentine 1 part; lemon juice, a few drops. The soldering iron is first dipped into the flux, then is applied to the solder in the usual manner.

An alloy of 80 parts zinc, and 20 parts aluminum has too high a melting point to be applied with a soldering iron. The flux has no value because it has no action on the film of oxide covering the aluminum which prevents the solder sticking. This film must be removed by scraping while the solder is flowing. The surfaces are first thoroughly cleaned, then the aluminum must be heated until the solder melts. It is made to *tin* the aluminum by thoroughly scrubbing the surface with the solder, or by melting the solder then scrubbing the aluminum under the solder. When the aluminum is tinned, ordinary half and half solder will adhere. Fluxes should not be used. They do not cause the solder to adhere but dirty the aluminum.

The following alloy is commonly used for solding aluminum: Tin, 86 per cent; zinc, 9 per cent; aluminum 5 per cent. Melt the aluminum in a crucible, add the zinc in the form of sheet, a little at a time. When all is melted stir well, and add the tin with more stirring. Pour into strips. To apply, heat the aluminum surface to the melting point of the solder, and scrub the latter on the aluminum, thus tinning the aluminum. The tinned surfaces then are soldered in the ordinary manner.

Nonferrous Metal Fluxes

We would like to learn what fluxes are commonly used in melting brass and bronze, also for aluminum alloys.

The important point in melting any alloy of copper is to protect the metal from the gases generated by the burning fuel, because it absorbs some of these gases, and combines with others, producing a metal that may be filled with holes like bread, or it may be mixed with dross formed by a combination of the gas and the copper and other metals in the alloy.

Anything that will cover the metal after it has melted, and will produce a gas that protects the metal before it is melted, is of great assistance to getting sound castings. For these purposes charcoal is universally used; hard wood blocks also are excellent. In addition to this protection it is advisable to use some flux such as a mixture of soda ash, sand and lime which melts and forms a glass that covers the surface of the metal. For ordinary red brass, bottle glass is quite satisfactory.

For aluminum flux use a piece of fused zinc chloride the size of a hazel nut to a crucible full of aluminum. Add the chloride after the aluminum is melted and before taking it from the furnace, by simply dropping it onto the metal and stirring.

Composition of Electric Contact Castings

We would like to obtain a formula for trolley wheels and other electric contact castings, which are high in conductivity and will wear well. The metal should be red in color. Any information you may be able to give will be thankfully received.

The conductivity of the metal in a trolley wheel is not so important as its nonarcing qualities. Some alloys, notably those containing much lead and also the copper-zinc alloys, form arcs as the wheel rolls along the wire. These arcs produce on the tread of the wheel little hard pimples which abrade the wire. The following alloy makes a good trolly wheel: Copper, 92.50 per cent; phosphor copper, 0.5 per cent; tin, 7 per cent. A copper-colored wheel can be produced by decreasing the tin and increasing the phosphor-copper, but its conductivity will be no greater than that of the alloy given first. More difficulty is experienced in casting it and getting clean castings, on account of the higher percentage of phosphorus. If any difficulty is experienced with 0.5 per cent of phosphor copper from he metal cutting into the sand, the amount used may be decreased, as 0.10 per cent phosphor copper is sufficient for deoxidizing purposes. For trolley ears and overhead fittings use the following alloy. Copper, 87 per cent; tin, 4 per cent; zinc, 6 per cent, and lead, 3 per cent. For electric contact castings use copper only where conductivity is important.

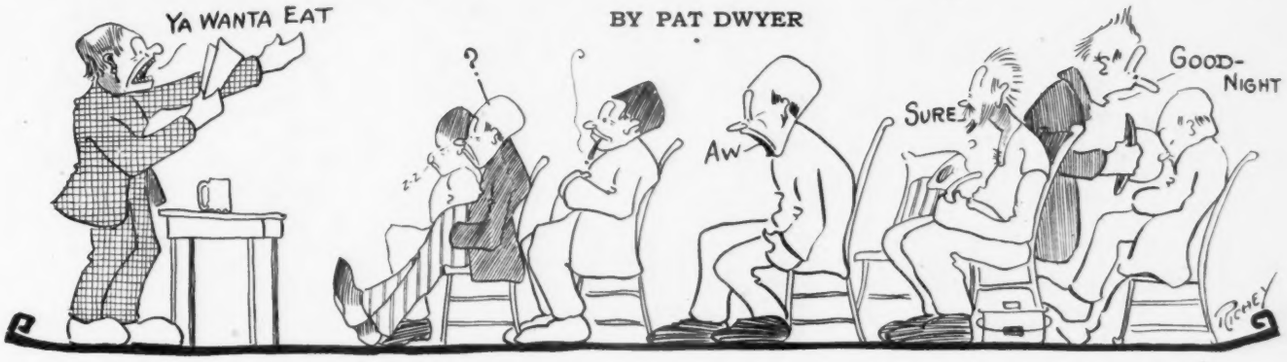
Bronze Bushing Alloys

We would like to obtain the formula for an alloy suitable for bronze bushings, that can be machined easily, will give good service and also be cheap.

The following alloy will fill the requirements satisfactorily: Copper, 78 per cent; tin, 7 per cent; lead, 15 per cent. If a deoxidizer is considered necessary add 0.25 per cent of a phosphor copper containing 15 per cent of phosphorous. First melt the copper under charcoal, add the phosphor copper and stir thoroughly, then add the tin and lastly the lead. This alloy will run clean castings and will prove an excellent bearing alloy.

Bill Makes a Steel Pinion For Large Mill Drive

BY PAT DWYER

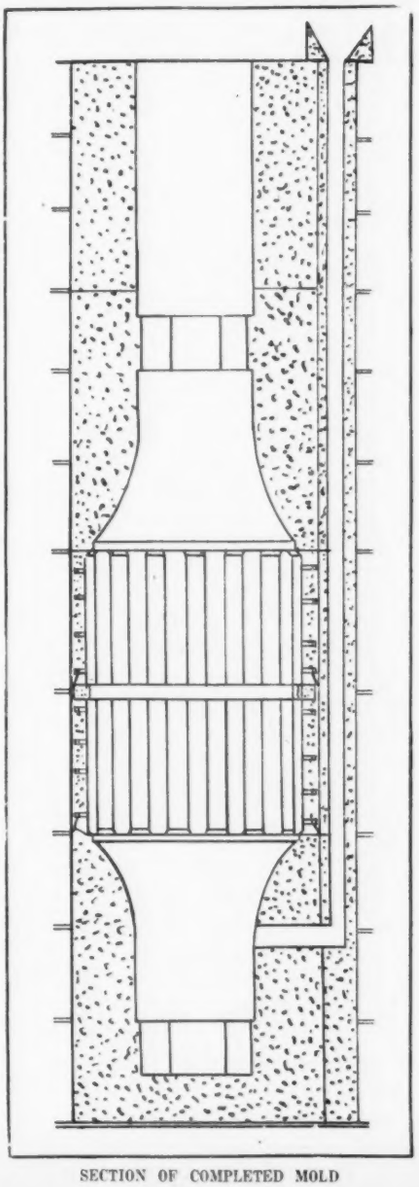


DURING a meeting which Bill and I attended one night recently a well-meaning citizen read a paper entitled, "The Importance of Selecting the Right Kind of Breakfast Food." Bill did not wait to hear it all; he told me that he would wait for me outside if I intended to be a goat and stay until the meeting was over. I will be honest enough to confess that it was politeness and not interest that prevented me from following his example, but I stayed. After the meeting was over I found him waiting and we walked together to the car line.

"That kind of drivel makes me tired," said he. "It is my opinion that it does not make a bit of difference what a man eats for breakfast or any other meal as long as he gets enough of it. At the present time, the burning question is not 'What shall we eat,' but 'What can we get to eat?' It is the same with any other question you wish to consider. For instance, there is a general impression among foundrymen that there is only one kind of sand in the world fit to make castings, and that is the kind they have always used. They pooh-pooh and laugh you to scorn, etc., if you suggest using any other kind, even in an emergency. Now I'll tell you about a double staggered tooth driving pinion for a blooming mill that I made one time under peculiar circumstances. This little episode occurred while I was connected (connected is good) with a comparatively new iron and steel plant.

"After the blooming mill had been running some time one of the main driving pinions broke and it was found that there was only one spare on the plant. An order was placed with the nearest steel foundry which in this case was 1000 miles away for a new casting and to guard against a shut-down the master mechanic decided that he would have a pair cast in the open-hearth department of the plant.

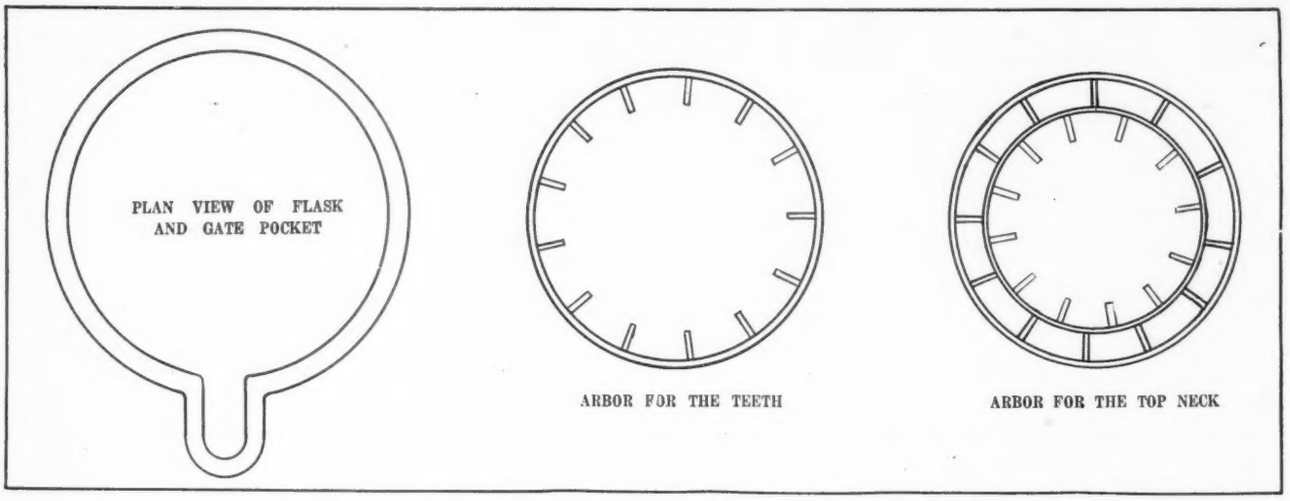
"We had no silica sand at the time, but we had in the iron foundry a large supply of different kinds of ordinary molding sand for iron and brass castings. Included in this lot was a supply of coarse, open sand which we used on dry sand and loam work Considerable doubt was expressed about the ability of this sand to stand up to steel. When the master mechanic asked my opinion, I told him that I saw no reason why it should not give satisfactory results. I don't mind telling you that I was not as confident as I led him to believe, but I was not going to miss such a beautiful chance to find out definitely. I'll say this for him, he was a brave lad for he took my word for it and convinced the general manager, the purchasing agent and the blooming mill superintendent that it could be done.



SECTION OF COMPLETED MOLD

"This casting was no toy. It was 3 feet in diameter across the teeth; it was nearly 15 feet long, including the sink head; and it required about 15 tons of steel to pour it. Having settled all the preliminaries, actual work was commenced by issuing shop orders for a pattern and a set of flasks to mold it in. The flasks all were cast and ready several days before the pinion pattern was given the last coat of yellow shellac. The core print around the middle was painted a brilliant vermillion and the *tout ensemble* certainly was handsome.

"The flask was made in 11 sections, nine of them were alike, being 14 inches while the other two were 26 inches deep. The two deep sections were to carry the teeth, three shallow sections were required to house each neck and wabbler and the remaining three sections enclosed the sink head. These flasks were made after the style of those used for making rolls. They were flanged top and bottom and were provided with an extension to accommodate the upright runner. One pattern 14 inches deep was used to make all the flask sections. It was the correct depth for them all except the two deep sections which were to contain the mold for the teeth To make the deep sections the pattern was rammed in the usual way and then drawn up and rammed again, until the required depth was reached. The pattern carried a top flange but the lower flange on each section was molded on by the use of flange cores. This arrangement did away with



ARBOR FOR THE TEETH

ARBOR FOR THE TOP NECK

the necessity for either lifting out the core or cheeking off the outside. The mold for the bottom plate for the flask was made by setting the pattern flange down on a prepared bed of sand and banking the sand around the flange to the depth of about an inch.

"We also made nine arbors, four for each set of teeth and one to carry the sand in the top neck section of the mold. Three of these arbors had long prongs cast on them, the purpose of which will be touched upon again. When the gear and rigging was ready we loaded it all on a flat car and had it taken down to the open hearth where the mold was made.

"For convenience in molding, the pattern was made in seven sections fitted together in the usual way with dowels and dowel pins; two wabblers, top and bottom neck, two teeth sections and a wide core print which separated the top and bottom sets of teeth. A segment corebox was provided for making these cores which were used for reducing the shrouding in the center to the pitch line and have it correspond to the shrouding on the extremities of the teeth.

"We put down an ordinary square wooden bottom board for a roll-over board, centered the bottom neck of the pattern on it, and then lowered on one of the 14-inch flask sections. A piece of 3-inch pipe about 4 feet long was placed in a vertical position in the pocket of the flask provided for that purpose. This served as a gate pin. Facing sand, which consisted simply of new sand passed through a No. 4 riddle, was used to cover the pattern to the depth of about 2 inches and then enough old sand was shoveled in to form a ramming. The piece of pipe also was surrounded by new sand. A piece of rod was bent and laid horizontally between the pipe and the flange of the pattern on the first ramming but no further rods were used. New sand was used to face the pattern and gatepipe all the way up. The other two flask rings were put on and successive courses of sand were rammed until it had reached a point about half way up on the neck. At this point the sand was scraped off flat and a small tunnel about 3 x 5 inches was built of silica brick connecting the pattern with the upright gate. The gate pipe was then withdrawn and a flat silica brick placed over the opening. This brick also served later to receive the direct fall of the metal during the pouring operation. The remainder of the drag was rammed in the usual way, a large portion of the space being filled with coke to facilitate drying the mold. The bottom plate was then clamped on and the drag rolled over. The roll-over board was removed and the parting slicked. The chamfer on the points of the teeth made it necessary to supplement this parting by setting on the section of the pattern containing the first set of teeth and tucking up under the points before putting on the parting sand. One of the 26-inch cheeks was then put on, the same piece of pipe which was used for a gate in the drag being set in and located by dropping one end into the opening in the joint. About ¼-inch of facing sand was sprinkled on the joint and one of the arbors which had three prongs on the lower side was clay washed and lowered in until the prongs rested on the sand strip with which each of the flask sections was provided on the inside at the bottom edge. Four gaggers were set in each tooth space and enough sand shoveled in to make the first ramming. The remainder of the ring was filled and rammed, three additional arbors being dropped in at equal distances. When the top was reached the surplus sand was scraped off and four 6-inch spikes inserted in the top of each tooth for reinforcement The joint was then slicked and the core print set on. The part of the pattern containing the second set of teeth was then located and the other deep section of flask was lowered on and rammed in a manner similar to the first.

"When the parting was made on this section, the second neck and wabbler were placed and three of the 14-inch flask sections hoisted into position. A suitable arbor or grating was lowered in which also rested on prongs provided for that purpose. This section of the mold was rammed up to the top of the wabbler. An 18-inch diameter ring pattern was set on top of the wabbler and the sand rammed up flush with the top edge of the flask. This ring formed the lower end of the sink head, or perhaps it would be clearer to say it formed the connecting link between the wabbler and the future green sink head. The remaining three sections of the flask were not rammed at this time; they were rammed up later in green sand when assembling the mold for casting.

BILL'S CAR MADE A CLEAN SWEEP

The top of the last section was scraped off flush, the ring pattern withdrawn, a round plate clamped on and then the work of taking the mold apart was begun. The section containing the top neck and wabbler was taken off first, turned and lowered to the floor. The pattern was drawn out, the mold finished and given a coat of silica wash. It then was rolled back again and set up on some empty flasks to enable us to build a wood fire under it.

"The first section of the teeth pattern was drawn next. We had to use one of the 75-ton open-hearth cranes to draw the patterns. The operator was an artist He drew those patterns as nicely and as steadily as any foundry crane man could do it. The upper cheek section was then lifted off and lowered upon suitable stands where it was finished and whitewashed. The lower cheek was treated in the same manner. The lower neck pattern was drawn last and the mold finished and whitewashed. We built wood fires under each section with the exception of the drag, which we dried with a gas flame.

"The open-hearth furnaces in this plant were the tilting type, set level with the floor, and having a pit in front in which the ladles were lowered while tapping heats. The complete pinion mold was 16 feet high from the bottom plate to the top of the runner, so we decided to assemble it in the pit of one of the furnaces which was temporarily off for repairs.

"Accordingly the drag was picked up first, carried to the pit and lowered down until the bottom plate rested on the brick floor. The two cheek sections containing the teeth were put together where they were and the ring cores which made the gap between the two sets of teeth were inserted. These cores had been dried in an oven improvised for the occasion out of a few iron plates. The two sections were clamped together, picked up by the crane and lowered on the drag in the pit. The cope section was then put on, a ring pattern placed in the riser, the remaining three sections of flask lowered on and rammed full of green sand.

"Instead of using a pipe for a runner in the green sand section, we used sleeve bricks built on top of each other. The mold was then clamped at the joints, a runner cup set on and we were ready to pour. We had no choice in the analysis of the metal We had to take either one of the different varieties of steel the open hearth was making at that time. The nearest to what we wanted was an axle mixture of about 0.45 per cent carbon. We poured it from that heat and I heard afterward that it was the best wearing pinion that was ever put into the blooming mill."

"How did the sand act?" I said. "Did it skin off all right?"

"Sure," said he. "The outside peeled off as clean as any casting you ever saw; we had to do some chipping in the teeth but I believe that would have been obviated if we had facilities for drying the mold properly in an oven."

Just then Bill's car came into view and as he stepped off the curb he handed me this little gem of wisdom: "It is all right for a young fellow to fuss over his breakfast food, but a married man, if he has any sense, will take what he gets and be thankful if he does not have to get up and prepare his breakfast as well as eat it."

Method of Making the Cupola Bottom

By H. E. Diller

Question—How and through what opening is the bottom made in a drop-bottom cupola? In England our cupolas have solid bottoms and openings are provided in the back, opposite the tap hole, for pulling out the unburned coke after the heat. With this method new bottom need be made only occasionally.

Answer.—In drop-bottom cupolas the two semicircular doors which form the bottom are swung down after every heat. This allows all the unburned coke, the slag and any metal which has not been melted to drop through to the floor. The refuse, in many foundries, is put through a water mill to reclaim all the iron in it. Not only does the refuse from the cupola fall out when the bottom is dropped, but the sand which formed the bottom comes with it. This necessitates the making of a new bottom after each heat. To do this the bottom doors are closed after the side walls of the cupola have been patched and the breast of the cupola has been made.

This patching is done with a mixture consisting of half molding sand and half fire clay and a hole for tapping is formed in the breast. Then sand is thrown in through the charging doors. A ladder is put through the charging doors and a workman goes down to tamp in the sand bottom. Usually the first layer about 2 inches deep is made of gangway or refuse sand. This is generally covered with a layer of molding sand of the same thickness. The sand should be damp but care must be taken that it is not too wet. Scrap wood is used to start the fire. It is laid on the bottom and stood up along the sides. At two or more tuyeres finer wood is placed with which to start the fire. After a portion of the wood has been placed the workman comes out of the cupola and withdraws the ladder. The remainder of the wood is then dumped on top of that already placed. A portion of the coke is also charged and then the fire is lighted. When a good fire is burning and a blue flame comes from all over the top the remainder of the coke for the bed is added. After a blue flame again appears charging of the metal begins.

British Foundrymen See German Practice

Recently a deputation from the British Brassfounders' association visited German works to study foundry conditions in the Rhineland. According to the *Iron and Coal Trades Review* this deputation has reported that the main advantage the German founder has is in the smaller variety of articles produced by each manufacturer combined with careful attention to details by all the employes.

An unusual practice was noticed which was common to all the German brass foundries visited. This consists of putting molds into an oven as soon as they are made and leaving them there until the next morning when they are taken out and poured at some time during the day.

Molds are placed on top of each other when cored, in piles 3 or 4 feet high. Each pile is clamped together and then set on end for pouring in the usual manner. It was noticed in several instances that loose locating pegs were inserted in the sand of the mold to assist in accurately matching the cope and drag. Both pit and tilting furnaces were employed for melting.

Organizes New Foundry

The Greensburg Foundry Co., Greensburg, Ind., has been organized with R. G. Dock, president, and J. E. Evans, secretary and treasurer. Mr. Dock will continue the operation of his machine shop as a separate organization, while Mr. Evans, who has been with the Dayton Malleable Iron Works, Dayton, O., will assume active management of the new foundry which will specialize in malleable automobile and jobbing castings.

The Keller Pneumatic Tool Co., Chicago, has been awarded the contract to supply the navy yards with all their requirements in pneumatic riveters, chippers, scaling hammers and holders-on for the present fiscal year. The first order was for 3946 tools divided as follows: Riveters, 881; chippers, 1428; scalers, 896, and holders-on, 291.

Learn Semisteel Facts From Shell

The Sum of the Percentages of Total Carbon and Silicon in the Metal is an Index of Its Strength—First Portion of the Heat is Found to be Inferior in Quality

BY FRANK E. HALL

WAR showed the necessity for a metal stronger than cast iron to supplement the supply of steel. So patriotic metallurgists were spurred to new efforts to improve the status of that half-breed of the metal world that had been, more or less erroneously, christened semisteel. As a result, it was developed that for certain purposes semisteel was superior to steel in the manufacture of shell.

Steel, because of its greater strength and toughness, is able to carry a heavier charge of explosive, consequently, a steel shell can be expected to cause greater destruction when used against fortifications or other inanimate objects. On the other hand semisteel, because of its comparative brittleness and its resulting greater fragmentation, is capable of inflicting more serious loss of life when used against opposing forces of men. Therefore, each has its proper place in the economy of war.

For the present purpose, steel may be defined as a comparatively pure iron whose physical nature is modified by small amounts of carbon, silicon, sulphur, phosphorus, manganese, and possibly other rare elements; while cast iron generally is limited to approximately 93 per cent of iron, the remainder consisting of larger percentages of carbon, silicon, sulphur, phosphorus and manganese. Semisteel may be defined as cast iron in which the carbon and silicon have been reduced to as low a point as is consistent with maintaining the nature of gray iron, and in which the remaining elements are manipulated so as to give the greatest strength.

The fact that the addition of steel scrap, in varying percentages, is the means used to reduce the carbon, together with the fact that a considerable increase in strength results, is probably the explanation of the origin of the name semisteel. That ordinary grades of steel show from three to four times the tensile strength of cast iron is due to the fact that the crystals, or grains, of cast iron are interspersed with flakes of graphitic carbon, which break up the continuity of the mass and form surfaces of cleavage, which weaken the whole structure. Ordinarily about 3 per cent of graphitic carbon is present in cast iron, but as the specific gravity of graphite is 2.15 and of cast iron 7.20, the space occupied by the graphite is upward of 10 per cent; so when it is considered that the graphite is present in flakes, or plates, and not in grains, the reduction in strength is easily understood. The production of semisteel involves a reduction of graphitic carbon to approximately 2.40 per cent. In addition, the reduced silicon content and other factors entering into the situation tend to change the flakes of graphite into finer particles of more compact shape, rendering the structure more homogeneous and, consequently, stronger. It is easily possible to double the strength of ordinary cast iron by the addition of steel scrap and the proper manipulation of the controlling constituents.

Chemistry of Semisteel

A number of features are of prime importance in securing consistent results when making semisteel. Foremost among them are the careful control of the chemical composition of the metal and extreme care in maintaining uniformly the proper melting conditions as well as the conditions surrounding the pouring and subsequent heat treatment of the castings. As increased strength is the main object sought, the carbon and silicon must be reduced. The extent to which this reduction may be carried is limited by the size of the casting, the material of which the mold consists, the subsequent heat treatment, and, to some extent, by the percentage of sulphur and manganese contained. The lower the total carbon, the greater is the tendency of the carbon to remain in the combined state for any given silicon content; so in order to safeguard the castings from "chilling white" it is necessary to increase silicon as the total carbon decreases. A generally accepted rule is that for a shell of 155 millimeter in diameter or larger, the total carbon plus the silicon should be maintained at approximately 4.40 per cent, although it will be seen from the analysis in the accompanying table that excellent results have been secured with a total considerably below this figure.

The total carbon is more difficult to control than is the silicon, for in the cupola, carbon is absorbed from the fuel in varying amounts, depending on the conditions surrounding the melting. As a result the total carbon is always greater than the calculated amount, and it is not always possible to forecast accurately the reduction that will result from the use of a given amount of steel scrap. The silicon, on the other hand, loses more through oxidation than is the case in melting ordinary gray iron. The variations of these two elements are such that accurate and rapid laboratory methods are imperative in order that as close control of the composition as possible may be maintained.

In addition to the requirement for high tensile strength, the manufacture of shells demands a certain degree of toughness, or freedom from excessive brittleness, to insure against breaking in the gun. This feature involves carrying a low phosphorus content, in addition to the precaution against allowing the total of the carbon and silicon to become so low that brittleness will result. In order to meet the present requirements in this respect, a phosphorus content not to exceed 0.120 per cent is desirable.

The effect of manganese is practically the same as in the case of ordinary gray iron and, as in the case of other low-silicon castings, is preferably carried from 0.75 to 1.00 per cent.

Sulphur, never a desirable constituent, tends to increase abnormally in semisteel, due to a number of conditions. Chief among these is the ready absorption of this element by the steel scrap, which necessarily consists of moderate-sized pieces. As these become red hot before the larger pieces of pig iron and require

Copyright, 1920, by the American Institute of Mining and Metallurgical Engineers, Inc. From a paper to be presented at the meeting of the institute, New York, Feb. 16 to 19. The author, Frank E. Hall, is director of laboratories, American Radiator Co., Buffalo.

greater heat to melt, they remain longer in contact with the sulphurous gases from the fuel. As the latter is required in greater amount in order to insure the proper melting of the steel scrap, it naturally furnishes more sulphur. The rigid requirements of the manufacture of semisteel shells involve a large percentage of remelt than in ordinary practice, which also tends to a higher sulphur content, so that special care in the selection of materials and attention to the details of the process are needed to insure as low a percentage of sulphur as possible.

In the accompanying table are given a number of selected analyses with the results of the accompanying tensile and impact tests and, in some cases, the brinell hardness. These analyses have been selected to cover as wide a variation as possible within working limits and, in a few cases, special portions of heats have been shown in which the impact test fell below requirements.

Semisteel Requirements

It is perhaps fair to remark that there was some uncertainty as to just what was necessary in regard to the strength of shells to meet the requirements so recourse was had to the tests developed in France for like purposes, with such modifications as it was thought would simplify their application to our system of weights and measures. It is probable that further study in actual service will be necessary before a system of tests can be devised that will, at the same time, safeguard the quality of the product and enable the manufacturer to produce satisfactory shells without sufferjng an abnormal penalty in rejected material. The tests, as finally outlined, were as follows:

Physical Tests—Test bars shall be taken from the pouring ladle at each cast of approximately 2000 pounds and each bar shall be cast in a vertical mold of the same material as that in which the shells are cast. The cooling of the test bars shall be performed under the same conditions as the cooling of the shells.

Tensile-strength Test—The test bar shall be cast 1.25 inches in diameter, with a length of 8 inches and a riser of 4 inches. At each end of the bar, for a distance not exceeding 2 inches, the bar may be cast with a maximum diameter of 1.5 inches, in which case the riser shall be of the same diameter. After removal of the riser, the test specimen shall be machined at its central portion to a diameter of 1.128 inches for a minimum length of 4 inches. The tensile strength of the specimen must be at least 32,000 pounds.

Impact Test—The test specimen 1.50 inches square, and not exceeding 1.52 inches on any side, shall be cast with a length of 8 inches and a 4-inch riser of the same area, between which and the bar there may be a neck of decreased area to permit the riser to be readily knocked off. After removal of the riser, the bar shall be placed on two angular supports having edges with a radius of 0.08 inch and in turn supported on a one-piece anvil weighing at least 1750 pounds and resting on a concrete or other solid foundation. A weight of 25 pounds, having its bottom curved on a 2-inch radius, shall be caused to fall exactly on the middle of the test bar. The test shall begin with the weight at a height of 12 inches and shall be repeated, always striking the same face of the test bar, with the height of the weight increased by ½ inch intervals until the bar breaks. The height of fall for causing rupture shall be not less than 18 inches, this height being measured from the upper surface of the bar to the lowest part of the testing weight.

Hardness Test—Hardness must not be less than represented by an indentation of 4.6 millimeters diameter on Brinell machines at 3000 kilograms.

A study of the accompanying table, and other data accumulated during a considerable period of manufacture, indicates that the impact test is more or less erratic, as at present applied.

The statement has at times appeared that too high a tensile strength was not advisable, for the reason that, above reasonable limits, the impact test was likely to show a brittle iron and that the toughest iron was apt to be that which ran rather close to the lower limit in tensile strength. While this statement has been borne out in a very few cases in the operations upon which this paper is based, by far the greater number of cases show an increasing toughness with increasing tensile strength, as in the case of numbers 11 and 13 of the table. Number 10 is one of the few exceptions mentioned.

Tensile Strength is Limited

There is a limit to which the tensile strength can be carried, however, for when the total carbon and silicon content falls much below 4.40 per cent, the semisteel becomes difficult to melt and is sluggish in the molds, so that slag and gases do not readily free themselves from the metal and defective castings result. For example, No. 13 shows a total carbon and silicon content of 3.87 per cent. While the tensile strength was above normal and the impact test showed good toughness, some of the test bars from this heat showed flaws from sluggish metal.

The total of carbon and silicon content below which it is unsafe to go is probably in the neighborhood of 4 per cent. It would not be wise to continue at this point for many heats in succession as, in addition to the liability to sluggish metal, there is danger of its chilling white unless carefully cooled, the more so as the remelt is returned day after day. The best results appear to lie between 4 and 4.40 per cent, with the total carbon remaining as near 3 per cent as possible and the combined carbon at or near 0.60 per cent. Analyses 2 and 2-*A* represent respectively the third and the thirtieth ladle from the same heat and are reproduced to show the tendency to weakness of the first metal from the cupola.

Second only to the necessity for careful chemical control is the need of a refined cupola practice, as it is easy to spoil an otherwise perfect mixture for semisteel, by lack of attention to details in melting. It is of the utmost importance that the coke bed be thoroughly ignited and leveled and that the charges be placed with the utmost care

Analyses and Tests of Semisteel Samples

	Mixture			Chemical analyses								Physical tests			
No.	Pig iron Per cent	Steel Per cent	Remelt Per cent	Silicon Per cent	Sulphur Per cent	Phosphorus Per cent	Manganese Per cent	Graphitic carbon Per cent	Combined carbon Per cent	Total carbon Per cent	Silicon and total carbon	Tensile strength Lb. per sq. in.	Impact test inches	Brinell hardness at 3000 kg.	Remarks
1	39.4	25.2	35.4	1.04	0.118	0.100	0.76	2.57	0.65	3.22	4.26	35,570	19½	4.25 m/m 4.50	
2	40.5	24.8	34.7	1.15	.....	.....	0.72	....	....	3.22	4.37	33,380	17½		Third ladle
2A	40.5	24.8	34.7	1.01	0.101	0.080	0.80	2.60	0.62	3.22	4.23	38,510	20½		Thirtieth ladle
3	41.4	24.4	34.2	1.37	0.107	0.094	0.80	2.54	0.60	3.14	4.51	34,080	19		
4	40.5	24.8	34.7	1.26	0.104	0.092	0.81	2.50	0.63	3.13	4.39	37,630	18		
5	34.1	30.4	35.5	1.09	0.121	0.111	0.55	2.35	0.65	3.00	4.09	34,960	19		
6	34.0	33.0	33.0	1.10	0.109	0.108	0.64	2.13	0.71	2.84	3.94	46,960	18		
7	38.9	23.5	37.6	1.40	0.095	0.102	0.70	2.42	0.64	3.06	4.46	41,310	19	4.3	
8	39.2	23.4	37.4	1.01	0.100	0.118	0.66	2.32	0.67	2.99	4.00	41,490	18	4.1 m/m 4.3	
9	39.5	23.3	37.2	1.43	0.110	0.112	0.58	2.49	0.47	2.96	4.39	44,910	20	4.0 m/m 4.1	
10	34.4	32.8	32.8	1.28	0.123	0.104	0.60	2.36	0.66	3.02	4.30	49,030	17		
11	33.7	33.1	33.2	1.07	0.111	0.120	0.61	2.35	0.66	3.01	4.08	47,220	20		
12	38.9	23.5	37.6	1.38	0.102	0.102	0.72	2.45	0.61	3.06	4.44	32,810	15	4.1 m/m 4.2	
13	33.6	33.2	33.2	1.06	0.118	0.106	0.60	2.09	0.72	2.81	3.87	43,440	20.5		
14	36.7	21.9	41.4	1.61	0.119	0.120	1.10	2.51	0.60	3.11	4.72	37,840	16.5	4.0 m/m 4.1	

to maintain compactness and uniformity and a proper division between the coke and metal layers; the cupola should be kept filled to the charging door.

As the material composing the charges for semisteel has a greater tendency to oxidation, it is important that careful attention be paid to the fluxing of the cupola. Limestone used alone is satisfactory, provided the heats are not more than 5 hours in duration. It should be from 7 to 10 per cent of the weight of the metal charge. A good depth of slag should be carried above the metal to admit of the thorough cleaning of the molten metal as it drips through this blanket of slag. For heats longer than five hours, it is advisable to substitute fluor spar for a portion of the limestone. From 15 to 20 per cent of the weight of the limestone may be replaced satisfactorily by fluor spar on heats up to 10 hours duration. It should be borne in mind, however, that fluor spar has about double the fluxing capacity of limestone in making the substitution, so that for every pound of fluor spar added, two pounds of limestone should be deducted.

It has been found satisfactory to place the charge of flux directly upon the coke. The steel, having a higher melting point than pig iron, should be charged immediately after the limestone, and it should be followed, in turn, by the pig iron and the remelt. The metal charge should be carefully leveled by filling the smaller pieces of the remelt into the crevices left in placing the pig iron.

More coke will be used in melting semisteel than is used in good gray iron practice, as the semisteel must come from the cupola extremely hot. Having a much lower carbon content, semisteel freezes at a higher temperature, and therefore needs to be handled at a higher temperature than gray iron. For the same reason, it should be handled rapidly and in large ladles to prevent too great a fall in temperature.

The great variation in composition, between the steel scrap used and the balance of the charge, necessitates a thorough mixing of the metal before pouring. To this end, it is advisable to make the charges as small as is consistent with pronounced separation of the layers of coke and metal in the cupola. This feature is also governed, to some extent, by the ability of the charging gang to maintain proper charging conditions. The smaller the charge the greater is the difficulty in keeping the materials properly placed and the cupola full, so that it may become necessary to use slightly larger charges than would otherwise be desirable for the sake of maintaining the best charging conditions, especially in the case of heats of long duration. A cupola lined to 66 inches, operated very successfully on a 2000-pound metal charge so long as the heats were of short duration but when the time was increased materially, it was found necessary to double the charge, using 4000 pounds of metal. In order to maintain proper mixing of the metal, a large mixing ladle is advisable, as well as large pouring ladles.

A good melting practice for semisteel demands coke of good quality and a bed charge approximately 36 inches above the top of the highest tuyere opening. The coke charges between the charges of metal should be in the ratio of from 1 to 8 or 1 to 7.

Owing to the inferiority of the first metal drawn from the cupola, it is advisable to pig the first ton or two of metal melted. The reason for the inferiority of this metal can probably be attributed to several causes; among these are the greater oxidation, resulting in a low and uncerain manganese and silicon content and the tendency of the gray iron to melt ahead of the steel. It is, therefore, advisable to make separate analyses of the first metal, which is pigged for remelt, and to treat it as a separate constituent in calculating the mixtures. In order to render the variation in this first metal as small as possible, the steel scrap used on the first charge should be in as small pieces in order that it may melt as nearly as possible at the same time as the gray iron. After the first ton or two of metal has been tapped into the mixing ladle, the cupola should be plugged and the ladle drained so that the subsequent metal will not be contaminated with the first metal drawn. When the metal is again tapped, it may be allowed to run continuously and the molten metal drawn from the mixing ladle into the pouring ladle as required.

The blast should be maintained at a uniform volume and of sufficient quantity and pressure to penetrate to the center of the melting zone. A satisfactory pressure for a cupola lined to 66 inches has been found to be from 14 to 16 ounces, when this pressure was maintained approximately 30,000 cubic feet of air per ton of metal melted was supplied to the cupola.

In regard to manipulation of semisteel during and after pouring, it is sufficient to state that standard foundry practice consistent with the best results in gray iron should be maintained.

Study Effect of Sulphur and Phosphorus

A COMMITTEE has been appointed through the efforts of the American Society for Testing Materials, the U. S. bureau of standards and the U. S. railroad administration, to investigate the effects of sulphur and phosphorus on steel. The personnel of the committee is as follows: Bureau of standards, represented by Geo. K. Burgess and H. L. Whittemore, Washington; U. S. railroad administration, represented by F. M. Waring, Pennsylvania railroad, Altoona, Pa., and H. E. Smith, Washington; American Society for Testing Materials, represented by Robert W. Hunt & Co., New York, and T. D. Lynch, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; Society of Automotive Engineers, represented by E. F. Gilligan, Henry Souther Engineering Co., Hartford, Conn.; Association American Steel Manufacturers, represented by E. F. Kenney, Midvale Steel Co., Philadelphia, and J. J. Shuman, Jones & Laughlin Steel Co., Pittsburgh; Steel Founders Society of America, represented by J. E. McCauley, Birdsboro Steel Foundry & Machinery Co., Birdsboro, Pa.; U. S. war department, represented by F. G. Langenburg, Watertown arsenal, Watertown, Mass.; U. S. navy department, represented by D. J. McAdam, naval engineering experiment station, Annapolis, Md.; U. S. shipping board, represented by Frank Gentles, Philadelphia.; National Research council, represented by John H. Hall, Taylor Wharton Iron & Steel Co., Highbridge, N. J.

Dr. George K. Burgess is chairman of the committee and the secretary is C. L. Warwick, secretary-treasurer of the American Society for Testing Materials, Philadelphia.

A program of tests has been outlined, which covers several different classes of rolled materials as well as forgings and castings. The tests are divided into two series designated *A* and *B*. In each series all factors will be kept as constant as possible with the exception of either the sulphur or the phosphorus. One of these elements will be varied in each series while every other element in the series will be held as constant as possible.

The ranges of phosphorus and sulphur in series *A* extend up to 0.08 per cent, and the sulphur in the steels of this series is to be *residual sulphur*, that is, sulphur present in the steel through fuel or from pig iron or scrap. Series *B*

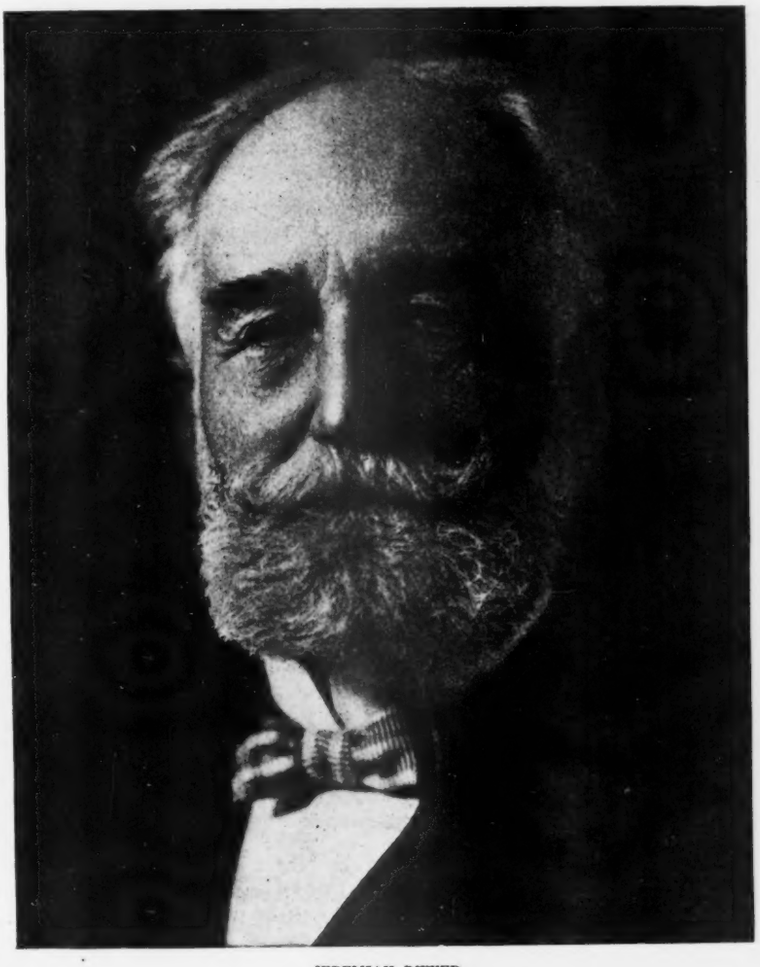
(*Concluded on page* 167)

Jeremiah Dwyer, Pioneer Stove Man, is Dead

JEREMIAH DWYER one of the pioneers of Detroit and moving spirit in the creation of one of the largest group of stove manufacturing plants in the world, died at his home early Thursday morning, Jan. 29, after a long illness. In accordance with his wish he was borne to his grave Saturday morning by eight of his old employes, a fitting end for one who started his career as a molder and climbing to the top of the ladder of success never lost touch with those in his service. Jeremiah Dwyer's career was typical of the industrial growth of the city of his adoption, it has been equalled perhaps by some but surpassed by few in rapidity of rise, or in qualities of courage, industry and vision. He was born in Brooklyn, N. Y., Aug. 22, 1838, the eldest son of Michael and Mary (O'Donnell) Dwyer who came to America from Ireland about the year 1818, settling near Hartford, Conn., later removing to Brooklyn, N. Y., where the father was an extensive contractor. A few years after the birth of Jeremiah the family moved to a farm in the vicinity of Detroit. Educated in the public schools of that city the boy was forced at the age of 11 to assume the burden of the head of the family, his father having been killed in a runaway accident at that time. He worked at various occupations for a few years and then served an apprenticeship at the trade of molding at the old Hydraulic Iron Works. After becoming a journeyman molder he worked for some time in Troy, Rochester and Buffalo. Returning to Detroit in 1861 he started a stove foundry in company with his brother, James, under the name of J. Dwyer & Bro. This business was subsequently incorporated under the title of the Detroit Stove Works, which plant was built under Mr. Dwyer's supervision and is still doing business.

In his early days he made the stoves by day and peddled them to down town stores at night. The Civil war created a demand that extended his market. In 1871 with Francis Palms, M. I. Mills, Charles DuCharme, George H. Barbour, and others, he founded the Michigan Stove Co., becoming president of what is reputed to be the largest stove manufacturing plant in the world. The buildings cover 360,000 square feet of ground and give employment to 1500 people. Jeremiah and James Dwyer were responsible for the inception of what is known as the base-burner, now in universal use. Applying for a patent the Dwyers found themselves involved in a long and bitter legal fight with, the then, leading stove manufacturers of the country. Because of the lack of financial resources he was at one time threatened with financial ruin, but his final success in establishing his rights in the courts made him one of the leading figures in the stove industry.

Mr. Dwyer resisted all appeals of friends at different times to enter politics. He did however, serve on the Detroit board of estimates for two terms and for nearly 24 years was commissioner of the House of Correction. His business connections were wide and various in spite of the fact that overwork early compelled a semi-retirement from any day to day attention to the details of his interests. At the time of his death he was connected with the Michigan Stove Co.; the Peninsular Stove Co.; Art Stove Co.; Michigan Copper & Brass Co.; Ideal Mfg. Co.; Michigan Fire & Marine Insurance Co.; Peoples State bank; First and Old Detroit National bank and the Security Trust Co. He was a member of the Detroit and Country clubs. For several years he was one of the conferees representing the Stove Founders' National Defence association at the annual conferences between that body and the Iron Molder's union and always exerted a powerful influence in those meetings. Four years ago his health was so impaired that the end was expected but he rallied and improved to such an extent that he was not considered in imminent danger until within a few hours of his death. He is survived by four sons and one daughter: John M. Dwyer, vice president of the Peninsular Stove Co.; William A. Dwyer, president of the Art Stove Co.; Emmett Dwyer, one of the vice presidents of the Michigan Stove Co.; Grattan L. Dwyer and Mrs. James J. Smith, of Cleveland.



JEREMIAH DWYER

THE FOUNDRY

A semimonthly journal devoted to all branches of the foundry trade

Published by

The Penton Publishing Co.

Penton Building, CLEVELAND

BRANCH OFFICES

BOSTON.....426 Old South Bldg.
CHICAGO.....1147 Peoples Gas Bldg.
CINCINNATI.501-505 Commercial Tribune Bldg.
NEW YORK.....2203-2206 St. Paul Bldg.
PITTSBURGH.....2148-49 Oliver Bldg.
WASHINGTON, D. C.....40 Metzerott Bldg.

FOREIGN OFFICES

BIRMINGHAM, ENG.....Prince's Chambers
LONDON, ENG 16 Regent St., Dorland House

Cable address, IROTRAPEN, London.

SUBSCRIPTION

United States and Mexico.....$2.00 a year
Canada.....$3.00 a year
Great Britain and other Foreign Countries.....$4.00 a year
Single Copies.....15 cents

Copies published three months or more previous to date of current issue, 25 cents each

ADVERTISING

All communications relating to advertising copy, discontinuances, etc., must be received on the 1st and 15th of the month preceding date of publication.

Member, the Audit Bureau of Circulation and Associated Business Papers Incorporated

ENTERED AT THE POST OFFICE AT CLEVELAND AS SECOND CLASS MATTER

Copyright 1920 by the Penton Publishing Co.

Contents

	Page
Piston Rings Cast Centrifugally	127
Handling Manufacturers to Hold Meeting	132
Advantages of Uniformity in Costs	133
Composition Alters Properties of Copper	135
Increases Blower Plant	135
Melting Iron With Powdered Coal	136
Castings for Ship Construction—XX	140
Machine Company Resumes Old Name	145
Ohio Company Starts Steel Foundry	146
Company Desires Data	150
Brass Foundry Specializes in Plumbers Fittings	151
Oppose Metric System	155
How and Why in Brass Founding	156
Aluminum Specifications	156
Soldering Aluminum	156
Nonferrous Metal Fluxes	156
Composition of Electric Contact Castings	156
Bronze Bushing Alloys	156
Bill Makes a Steel Pinion For Large Mill Drive	157
Method of Making the Cupola Bottom	159
British Foundrymen See German Practice	159
Organizes New Foundry	159
Learn Semisteel Facts From Shell	160
Study Effect of Sulphur and Phosphorus	162
Jeremiah Dwyer, Pioneer Stove Man, is Dead	163
A Little Oil Works Wonders	164
Trade Outlook in Foundry Industry	165
Comings and Goings of Foundrymen	166
Acquires New Plant	166
What the Foundries Are Doing	167
Trade Publications	168

A Little Oil Works Wonders

AT VARIOUS times men have been impressed by the exhausting nature of manual labor incident to foundry work and have cast about for mechanical devices which would perform operations more easily and readily. In other instances the motive has been to increase the output of the operator in a given period of time, rather than to render his work lighter. It should be realized in all cases where it is desired to introduce machinery for doing some specific piece of work that the change from hand methods will prove comparatively expensive. Therefore, the equipment must work satisfactorily after it has been installed if it is to pay the initial costs and meet the requirements for which it is intended. There have been instances where ideas have been brought into existence full-fledged, and developed into commercial possibilities with little or no experimenting. These instances form exceptions. As a rule every idea of this character has been conceived and brought forth in a nebulous state, requiring more or less experimental work on the inventor's part before it has been reduced to a working basis. In fact it is almost universally true that the co-operation of other men, with different viewpoints, has been required to round out the original idea and make it work.

Mechanical equipment designed for use in foundries has to meet more rigorous tests and operate under more adverse conditions than almost any other form of machinery. Joints, bearings, hinges and sliding parts are constantly subject to the deteriorating influences of an atmosphere saturated at times with smoke, steam and dust. The dust, too, is peculiarly abrasive. In molding machines, sand cutters and sand mixing and conveying machinery this condition is aggravated on account of the amount of loose sand which constantly accumulates on the parts not actually in motion. Unless constant vigilance is observed by those operating the machinery the sand will work into the bearings and other parts on which the smooth and efficient operation of the machine depends. This will result in slowing down production or will render the machine useless in extreme cases. No machine is absolutely fool-proof and no machine, no matter how carefully designed or how well it is adapted to the use for which it was designed and constructed can function unless it receives a reasonable amount of care and attention.

The two main requisites for operating machinery, especially foundry machinery, in an efficient manner, are cleanliness and lubrication. There are other details to be observed if a maximum output is to be expected from the installation but if one or both of these main features are neglected the machine will prove a liability instead of an asset. One or more men, depending on the amount of mechanical equipment used, should be detailed to examine all machines once or twice each day and see that all working parts are properly lubricated. It also should be part of the inspector's duty to instruct the men operating each piece of machinery so that they understand how the machine functions and to impress on them that care on their part will result in smoother and steadier operation with a resulting increase in the pay envelope. In the last analysis, that is the most powerful argument that can be applied to induce care in handling machinery.

Trade Outlook in the Foundry Industry

TRANSPORTATION difficulties continue to annoy castings manufacturers. Deliveries of raw materials are improved over the latter part of January, but still are far from satisfactory. In the coke regions, cars are available for about 50 per cent of the demand, which is at least 20 per cent below the number which could be loaded, were the cars available. Iron shipments, too, continue to lag, both through traffic difficulties and car or motive power shortage.

Iron Demand Heavy

Tonnages of pig iron sold during the past two weeks have exceeded any similar period in the past six months. This condition has been practically universal. The mounting demand for basic grades has occasioned concern, especially among those foundries which have purchased from merchant furnaces which swung over from basic to meet the demand for foundry grades. Prices have continued to strengthen, the $40 mark has been reached and passed, with no sign of weaking even in last half demand. High silicon irons, and other special alloy grades, show a diminishing supply, particularly for the first half delivery. Pig iron production is improving. According to *The Iron Trade Review*, production of coke and anthracite pig iron in January was 3,017,192 tons continuing the gains shown by the two preceding months. This figure is 2,626,074 tons in advance of the total for December. This represents 97,328 tons per day or 12,617 tons per day gain over the last month of last year. The improvement is better shown by the fact that it is 14.9 per cent advance in one month. The merchant output for January was 715,055 tons as compared with 653,792 for December, an increase of 61,263 tons. This represents 23,066 tons per day, compared with 21,090 tons for the previous month, a gain of 9.37 per cent. The gain in number of stacks in blast is also significant of the acceleration in iron production. Fourteen merchant furnaces were placed in blast and five were banked or blown out, giving a net increase of nine for the past month.

Prices of Raw Materials for Foundry Use

CORRECTED TO FEB. 6

Iron		Scrap	
No. 2 foundry, Valley	$40.00	Heavy melting steel, Valley	$28.00 to 29.00
No. 2 Foundry, Birmingham	40.00 to 41.00	Heavy melting steel, Pittsburgh	29.00 to 29.50
No. 2 Foundry, Chicago	40.00 to 42.00	Heavy melting steel, Chicago	25.75 to 26.00
No. 2 Foundry, Philadelphia	43.10 to 45.35	Stove plate, Chicago	36.00 to 36.50
Basic, Valley	40.00 to 41.00	No. 1 cast, Chicago	44.00 to 44.50
Malleable, Chicago	40.50 to 42.50	No. 1 cast, Philadelphia	37.00 to 39.00
Malleable, Buffalo	41.25 to 42.25	No. 1 cast, Birmingham	29.00 to 30.00
Coke		Car wheels, iron, Pittsburgh	41.00 to 42.00
Connellsville foundry coke	$7.00	Car wheels, iron, Chicago	39.50 to 40.00
Wise county foundry coke	8.25	Railroad malleable, Chicago	34.50 to 35.00
		Agricultural malleable, Chicago	34.50 to 35.00

Orders Are Plentiful

Probably at no time previously in the history of the foundry industry, has the demand for castings been heavier. Eastern manufacturers are seeking to buy castings in the west, and western buyers are inquiring in the east for any available foundry capacity. During the past few months an unprecedented amount of new plant construction has been undertaken. Many foundry equipment manufacturers state that December excelled any previous month in their business experience in the volume of orders from foundries either for new construction or for plant extensions. In the face of building material scarcity, high prices, and the increased cost of construction labor, this expansion can mean only that the foundrymen in general feel that the present prosperity is well founded, that a continuation of the demand for castings may be expected, and that additional facilities are essential. It will be remembered that the present strong buying movement which has brought such unprecedented business to practically every class of the industry, started with the automobile manufacturers. Many have been of the opinion that the makers of passenger automobiles had overestimated their 1920 requirements and early February, following the show season, would see retrenchment and cancellation of castings orders. The contrary result is noted. The manufacturers in many cases have still further expanded their production schedules. With the daily average production of 12 representative automobile manufacturers 150 per cent greater during the latter part of 1919 than it was during the first few months, and every effort being expended to increase this output, the demand for automobile castings is explained. Transportation troubles ble are forcing many foundries in Michigan and northern Ohio to deliver castings by motor truck to automobile factories. Railway buying still hangs upon the decision of congress relative to the return of the roads. Repair work is plentiful. Larger malleable shops which specialize in railway work are filled to capacity with repair orders. Inquiries for some 10,000 cars in the Chicago district, probably will not be transformed into orders until some definite decision is made on the terms of the return to private ownership. Manufacturers of farm implements and machinery recently have completed a survey covering the probable needs for 1920. It is stated that the demand for this class of equipment will be fully 50 per cent larger in the present year than it was in 1919. This is based upon the plans to raise larger crops this year, the shortage of farm labor which must be replaced by machinery, and the buying power of the rural communities which has increased due to the high prices paid for last year's crops. This demand will be reflected in the foundry industry. In fact some makers of farm tractors, and a large manufacturer of plows with plants in a number of cities even at this time are seeking castings from outside foundries, although previously their own plants have supplied their demand easily. Home building, and new construction continue to support a strong demand for all classes of domestic castings. This is particularly true of plumbing fixtures. Nonferrous prices, based on New York quotations, follow: Copper, 18.25c; lead, 8.75c to 8.87½c; tin, 58c; antimony, 11.50c to 11.75c; aluminum, No. 12 alloy, producers' price, 31.50c and open market, 30c to 31.50c. Zinc is 8.75c, St. Louis.

Comings and Goings of Foundrymen

G. M. LEWIS, who for the past six years has been sales manager and later secretary-treasurer of the Hill and Griffith Co., Cincinnati, resigned from that company, Jan. 1, and since has become associated with the E. J. Woodison Co., Detroit, in the capacity of general sales manager. Mr. Lewis was born and educated in Cincinnati and obtained his early training in that city. His first connection was with the Procter & Gamble Co. shipping department. He remained with that company through several departments, for about eight years. Later, he was superintendent of one of the largest maraschina cherry preserving plants in the country, and following this he took up expert accounting work with Ernst & Ernst. He left there to become associated with the Hill and Griffith Co.

Paul R. Beardsley, secretary-treasurer of the Piston Ring Co., Muskegon, Mich. has been elected mayor of that city.

E. L. Krome, formerly machine shop superintendent, American Blower Co., Detroit, has been made foundry superintendent.

R. B. Fisher, assistant to the president of the Buda Co., Harvey, Ill., has been made general sales manager for domestic and foreign sales.

J. H. James, formerly assistant manager, Monarch Steel Castings Co., Detroit, has been appointed foundry superintendent of the Foundry & Machine Products Co., Detroit.

Arthur G. Henry, metallurgist for the Illinois Tool Works, has become special representative for the Vanadium Alloy Steel Co., Latrobe, Pa., with offices at 566 West Randolph street, Chicago.

Albert Fagle, formerly machine shop superintendent of the Advance-Rumley Co., Battle Creek, Mich., has been appointed general superintendent of the plant, succeeding W. D. Creque.

Charles D. Steinmeyer, for many years connected with the Nordyke & Marmon Co., Indianapolis, as foundry superintendent, has joined the western sales force of the American Foundry Equipment Co.

Thomas N. Burman, formerly associated with the Hammer-Bray Co., Oakland, Cal., manufacturers of light gray iron castings, is now affiliated with Dow-Herriman Co., engineers and founders, San Francisco.

George S. Winner, general manager of the Cleveland Rubber Mold & Foundry Co., has been elected treasurer of the company. He will assume his new duties in addition to those of general manager.

J. M. Moore, who resigned as foundry superintendent of the Russel Wheel & Foundry Co., Detroit, Mich., over a year ago to accept a similar position with the American Blower Co., of that city, has resigned his latter connection and returned to the Russel Co., in his old capacity.

M. A. Beltaire Jr. has been placed in charge of the Detroit office recently opened at 805 Hammond building by the Booth Electric Furnace Co., Chicago. A branch office also has been opened in the Brown & Marx building, Birmingham, Ala., in charge of Gassman & Cunningham.

E. M. LEWIS

Frederick A. Merliss has been elected vice president and appointed manager of sales for the United Smelting & Aluminum Co., Inc., New Haven, Conn. He has been connected with the company for the past three years as assistant secretary and his appointment fills the place left vacant through the resignation of L. M. Brile.

C. E. Boyd, formerly connected with Timken-Detroit Axle Co., Canton, O., and recently foundry superintendent of the Saginaw Malleable Iron Co., Saginaw, Mich., has been made new manager of Marshall, Mich., plant of the Flint Foundry Co., which will be exclusively devoted to the production of automobile castings. The main plant and offices will continue at Flint, Mich.

M. T. Mortensen, formerly master mechanic and chief engineer of the Michigan Steel Castings Co., and Aluminum Manufactures, Inc., Plant No. 2, respectively Detroit, Mich., has resigned his last named connection and joined the city sales force of the J. W. Dopp Co., Detroit, Mich., representatives of foundry equipment manufacturers.

Hutton H. Haley, who has been affiliated with the Sand Mixing Machine Co., of New York City, in a sales capacity since 1911 and who as western district manager has handled the western sales of the succeeding company, the American Foundry Equipment Co., since 1915, has been made second vice president of the latter corporation.

Joseph E. Vincent Jr., 55 Liberty street, New York City, has been appointed eastern sales representative of the Massillon Steel Castings Co., Massillon, O., manufacturer of all kinds of steel castings, particularly those used in the automotive and railroad industries. He also represents the Peerless Drawn Steel Co., Schwart-Hermann Steel Works, Inc., and is an owner and general manager of the Iron, Steel, Metal & Alloy Co. In addition to the New York office a branch office is maintained at 120 Franklin street, Boston, in charge of C. H. Dayton, and within the near future an office will be opened in Philadelphia to supply the trade in Pennsylvania, Delaware and Maryland.

Acquires New Plant

The plant and business of the Buch Foundry Equipment Co., York, Pa., has been acquired by the American Foundry Equipment Co., New York, which is a recent consolidation of the Sand Mixing Machine Co. and the Rich Foundry Equipment Co. R. S. Buch who has been prominently identified with the molding machine industry for many years, will continue to be affiliated with the American Foundry Equipment Co. and will be in charge of the further development of his line of molding machine, flasks, etc., as well as their sale. The Buch plant at York, Pa., will continue to be operated until the new plant that is being erected by the American Foundry Equipment Co. at Chicago, is completed. It is the intention to concentrate all of the manufacturing operations of the American

Foundry Equipment Co. at this plant about May 1, which will afford 52,500 square feet of floor space and is being erected on a site at Forty-seventh street, near Kedzie avenue. When this plant is completed the works at Cleveland and York, Pa., as well as the existing Rich plant in Chicago will be dismantled.

Study Effects of Sulphur and Phosphorus

(*Concluded from page* 162)

is designed to carry higher sulphur than can usually be obtained as residual sulphur. In this series sulphur may be added during the latter stages of manufacture. The committee has decided to study first the effect of sulphur inasmuch as this presents the most urgent economic problem.

Much interest has been shown in this investigation. The manufacturers in particular have given it their hearty support, having agreed to furnish the material necessary to conduct the investigation. The government departments have offered the facilities of their laboratories for making tests, as have also the manufacturers and several of the large railroads which have been approached. The various interests represented on the joint committee have agreed to assume such expenses of the investigation as arise naturally in the course of their participation therein, so that up to the present the joint committee has not found it necessary to raise a general fund for this purpose. Although the committee has been formally in existence only for some two months, it has made a good beginning. The following committees have been appointed:

Committee of statistics, H. L. Whittemore, chairman; committee on manufacture, Geo. K. Burgess, chairman; committee on tests, F. C. Langenberg, chairman.

A combination spray can and mold dryer has been put on the market by W. A. Roedell, Kingstown, N. Y. This dryer will burn either fuel oil or kerosene. It will operate on from 10 to 25 pounds of compressed air.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

The Benton Harbor Malleable Foundry Co., Benton Harbor, Mich., plans the erection of a power plant.

The Dover Mfg. Co., Dover, O., is making some extensions to its foundry.

The Hudson Brass Co., Brooklyn, N. Y., is reported planning to build a plant at Ogdensburg, N. Y.

The Strong Steel Foundry Co., Buffalo, is reported planning the erection of an addition to its plant.

Erection of an addition to its foundry, is contemplated by the King Foundry, St. Joseph, Mo.

The Reading Stove Works, Canal street, Reading, Pa., plans alterations and repairs to its plant.

The Diversey Foundry Co., Chicago, is reported planning the erection of a foundry at Janesville, Wis.

The General Fire Extinguisher Co., Warren, O., is getting a site ready for the erection of a modern gray iron foundry.

The Anderson Foundry & Machine Works, Anderson, Ind., is reported planning the erection of an addition to its plant.

Peter Peterson, Muskegon, Mich., has leased the plant of the Foote Axle Burr Co. at Marshall, Mich., and plans to utilize the building for a brass foundry.

The North Buffalo Foundry Co., 747 Hertel avenue, Buffalo, contemplates the erection of a foundry, 70 x 100 feet.

The Niagara Pattern & Model Works, 1453 Niagara street, Buffalo, is reported planning the erection of a pattern shop.

Erection of an addition to its plant, is contemplated by the J. W. Pohlman Foundry Co., Buffalo. The building will be 59 x 92 feet.

Reus Bros., 146 W. Mt. Royal avenue, Baltimore, is having plans drawn for the erection of a foundry, 100 x 200 feet.

Erection of an addition to its foundry, to be 100 x 110 feet, is being planned by the Raritan Foundry Co., Raritan, N. J.

Capitalized at $25,000, the Campbell Stove Co. recently was incorporated at Rutherford, N. J., by William Bell, Colin Campbell and F. W. Conklin.

Erection of an addition to its plant is being planned by the Globe Malleable Iron & Steel Co., 101 Greenway avenue, Syracuse, N. Y.

Heggem & Davis, 624 Kennedy building, Tulsa, Okla., plan to erect a foundry and machine shop at Collinsville, Okla., each building to be 90 x 100 feet.

Capitalized at $100,000, the Adams Foundry & Machine Co., Youngstown, O., recently was incorporated by F. G. Friedrich, John Salato and others.

Capitalized at $10,000, the Active Castings Co., Detroit, recently was incorporated by Joseph C. Green, 788 Seminole avenue, and others.

The Stoke Foundry Co., Coldwater, Mich., recently was chartered with $100,000 capital, by Samuel D. Strong, and others.

Work is expected to start shortly on the erection of a plant, to include a machine shop and foundry, for the Iowa Machine Works, Clinton, Iowa.

The Saco-Lowell Shops, Biddeford, Me., has let the contract for the erection of a foundry and a 5-story, 38 x 300-foot storehouse.

The capital stock of the Buckeye Castings Co., Lima, O., recently was increased from $10,000 to $25,000.

Capitalized at $100,000, the Cuyahoga Foundry Co., Cleveland, recently was incorporated by E. Knapp, V. Foukal and others.

The A. Plamondon Co., Chicago, J. T. Benedict, president, 24 North Clinton street, is building a foundry and machine shop, 200 x 500 feet.

Bids have closed for the erection of an addition to the foundry and machine shop at the Charlestown navy yard.

William E. Harmer and Frank Clark, Franklin, Pa., will rebuild the plant of the Venango Bronze & Metal Co.

The capital stock of the Cincinnati Aluminum Castings Co., Cincinati, recently was increased from $20,000 to $75,000.

Fire recently damaged the plant of the Greey Foundry Co., Church and Esplanade streets, Toronto, Ont.

The W. A. Mills Brass Co., Port Chester, N. Y., recently was reorganized with an active capital of $150,000.

The Barcalo Mfg. Co., 225 Louisiana street, Buffalo, manufacturer of brass and metal beds, has increased its capital from $300,000 to $1,000,000.

The Indianapolis Stove Co., Indianapolis, is having plans prepared for the erection of an addition to its foundry.

The Pennsylvania Casting & Machine Co., Keystone building, Pittsburgh, is considering the erection of a 2-story building, 29 x 39 feet.

The capital stock of the Wisconsin Aluminum Foundry Co., Manitowoc, Wis., recently was increased from $100,000 to $200,000, and plans are being prepared for the enlargement of the company's plant.

The Central Mfg. Co., Kalamazoo, Mich., contemplates the erection of a plant to include a brass smelting room.

The Campbell, Wyant & Cannon Foundry, Muskegon, Mich., contemplates the erection of a plant addition.

Erection of a plant addition is reported being contemplated by the Lakey Foundry Co., Muskegon, Mich.

A gray iron foundry, 100 x 150 feet, will be built by the Iron Products Corp., La Crosse, Wis. Plans are now being prepared for the building.

The Euclid Foundry Co., Euclid Village, O., recently was incorporated with $100,000 capital, by C. Yanchar, J. Kubiese, Joseph Pogrjc and others.

The Bessemer Gas Engine Co., Grove City, Pa., has purchased land on which it plans the erection of a foundry and pattern shop. It also plans to erect 50 dwellings for its employes.

The Pulaski Foundry & Mfg. Co., Pulaski, Va., recently increased its capital from $50,000 to $150,000, and is reported having plans prepared for doubling its capacity.

Organization of the New Process Foundry Co., 165 South Rio street, Los Angeles, recently was effected, by William Walsh and others, and the company will engage in the manufacture of castings.

The McCoy Bronze Co., Detroit, has been incorporated with $40,000 capital, by J. E. McCoy, 206 Mt. Vernon avenue, and others, and will engage in the manufacture of bronze, brass and copper products.

Lockwood, Greene & Co., Boston, are drawing plans for the erection of a foundry addition and office extension for the Crosby Steam Gauge & Valve Co., Charlestown, Mass.

The Griffith Foundry Co., Griffith, Ind., recently was incorporated with $50,000 capital to engage in the manufacture of iron products, by H. C. Stuart, C. F. Holt and S. E. Stuart.

The Champion Foundry Co., Piqua, O., has been incorporated with $50,000 capital, by J. E. Bryan, Charles L. Hinsch, C. F. Stickler, L. A. Frazier and Maurice Wolfe.

The Economy Brass Mfg. Co., Cincinnati, has been incorporated with $20,000 capital, by M. Bachrach, W. E. Rutter, P. P. Bundman, Joseph Matthew Pfeiffer and Louis Katz.

The J. E. Steinmeier Bronze Works, New York, recently was incorporated to make tablets and bronze

castings, with $25,000 capital, by J. E. and L. M. Steinmeier and E. H. Fitch, 2694 Valentine avenue.

The American Stove & Range Co., Minneapolis, has bought a site at East St. Louis, Ill., on which it is reported planning to erect a modern stove foundry.

The Lynchburg Foundry Co., Lynchburg, Va., has awarded a contract for the erection of an addition, 120 x 230 feet, to be equipped as a pipe shop and foundry.

The Greenville Iron Works, Inc., Greenville, S. C., founder and machinists, has purchased property on which it plans to build an additional foundry and machine shop.

H. E. Beck and William Gallagher, Dennison, O., are reported planning to organize a company which will engage in business at Uhrichsville, O., as a founder and machinist.

The M. A. Love Mfg. Co., founder and machinist, and the Ward Pump Co., both of Rockford, Ill., are reported planning to consolidate as the Ward-Love Pump Corp., with a capital of $1,500,000.

The Illinois Foundry & Specialty Co., Morris, Ill., has purchased the Hart foundry at the foot of Hancock street, Peoria, Ill., which it will put into operation.

Contractors are completing the erection of a foundry for the Blackmer Rotary Pump Co., Petoskey, Mich., which will be devoted to the manufacture of pump castings.

L. R. Bliss, C. F. Bliss and F. N. Ames recently were named as the incorporators of the American Castings Co., which was chartered with $50,000 capital, at Corry, Pa.

Plans are being prepared for the erection of an addition to the iron and brass foundry of the Gilbert & Barker Mfg. Co., West Springfield, Mass. The building will be 40 x 400 feet.

The Chas. Jurack Pattern Works, Milwaukee, recently increased its capital from $50,000 to $150,000, in order to finance the equipping of a plant extension.

The White Metal Mfg. Co., 1006 Clinton street, Brooklyn, N. Y., is having plans prepared for the erection of a plant to include a main 6-story building, 35 x 135 feet, and a 2-story foundry, 20 x 80 feet.

The Accurate Brass Casting Co., Brooklyn, N. Y., which was recently formed, is said to be planning the erection of a foundry, 80 x 90 feet. Brass as well as other metal castings will be manufactured.

The Novo Engine Co., Lansing, Mich., has started on a large building expansion program, calling for additions and increased equipment. A foundry addition, 120 x 200 feet, and a machine shop, 90 x 280 feet, are under construction.

The Royal Brass Foundry Mfg. Co., McWhorter street and New York avenue, Newark, N. J., has been organized to manufacture brass, copper and other castings, by August C. Fuchs, 304 Oliver street, John Musto, 29 Bedford street, and others.

Plans have been prepared for the erection of a building, 80 x 200 feet, to be divided in three bays, the center one to be equipped with a crane, for the Hill-Curtis Co., Kalamazoo, Mich. The company is asking for bids for the erection of the structure.

The American Foundry Co., Milwaukee, is being organized and will have a capital of $100,000. Those interested in the company are planning to erect a gray iron foundry to be devoted to the manufacture of automobile castings, and a site has been purchased at Park and Ninth streets.

The East Hampton Foundry Co., East Hampton, Conn., which started business last spring, recently incorporated and changed its name to the Valley Foundry Co., Inc. The company has a capital of $50,000, and plans to build a new foundry, 50 x 110 feet with an extension, 28 x 60 feet. It will do light work up to 1000 pounds.

Proceeds from the sale of new stock being issued by the Cincinnati Steel Castings Co., Cincinnati, will be used to build an extensive addition to its molding department. Two electric furnaces will be installed. The company is increasing its capital from $50,000 to $100,000 and has acquired two acres adjoining its plant, upon which several foundry buildings will be erected in the future.

Plans have been completed by Engineers for the erection of an extension to the foundry of the Perkins Corp., Mishawaka, Ind., manufacturer of wind mills, towers, pumps, well supplies and gray iron castings. When completed it will double the capacity of the plant. C. A. Carlisle is president.

The Vulcan Foundry Co., 33 Hermon street, Worcester, Mass., which was formed to manufacture brass and bronze castings with $10,000 capital, operates a foundry in the rear of 35 Hermon street, and contemplates the installation of an additional cupola for the production of iron castings. Robert J. Molt, Samual Seder and G. W. Wood are the incorporators of the company.

The Homer Furnace Co., which recently removed its business from Homer, Mich., to a large new plant at Coldwater, Mich., is erecting a foundry, 128 x 150 feet, for the use of the Strokel Foundry Co. The latter company was recently organized to produce jobbing castings and has started operations in a part of the Homer plant. The foundry to be built will form an addition to the plant of the Homer Co.

The increase in business of the H. Kramer & Co., Chicago, has been so rapid, that the company has found its new plant at 1324-44 West Twenty-first street, into which it recently moved, too small for the heavy demands for its products, and have purchased 25,000 square feet of land adjoining its plant, on which it will erect an addition to its foundry. The addition will be equipped with a large cupola, 25 pit furnaces, four large reverberatory brass and dross furnaces, 15 white metal kettles, extra tables and concentrating department, as well as many other modern improvements.

New Trade Publications

SAND CUTTER.—The American Foundry Equipment Co., New York, is circulating a folder, containing a list of foundries which use its sand cutters.

HOISTS.—Electric hoists, overhead traveling cranes, revolving locomotive cranes, electric telphers, etc., are described and illustrated in a booklet recently published by the Link-Belt Co., Chicago.

ARC WELDING.—The U. S. Light & Heat Corp., Niagara Falls, N. Y., is circulating a bulletin in which electric arc-welding equipment is described and illustrated. The booklet also contains a number of characteristic curves.

FOUNDRY EQUIPMENT.—The Northern Engineering Works, Detroit, is circulating an illustrated booklet, in which general foundry equipment, including cupolas, cranes, ladles, etc., are described and illustrated. Detailed information concerning the various items is given as well as specifications, etc.

FOUNDRY EQUIPMENT.—The W. W. Sly Mfg. Co., Cleveland, is circulating a large cardboard folder, in which recent foundry installations, including a cupola, core ovens, sand blast rooms, dust arresters, exhaust mills and sand blast mills, are described. The descriptions are accompanied by illustrations.

LABOR-SAVING EQUIPMENT.—A booklet of 108 pages is being circulated by the Link-Belt Co., Chicago, in which freight and package handling machinery and other labor saving devices, such as elevators and conveyors, is described and illustrated. The booklet is profusely illustrated, showing the various uses to which this equipment is adapted.

ENGINEERING SERVICE.—An illustrated booklet has been published by the Service Engineering Co., New York, in which details of engineering service rendered by the company and covering plant and machine tool appraising, planning, complete tooling systems, design and building of tools, special and automatic machinery and the development of inventions, is discussed.

ELECTRIC CRANES.—A bulletin recently was issued by N. B. Payne & Co., 25 Church street, New York, agents for the Lane Mfg. Co., Montpelier, Vt., describes and illustrates several styles of cranes in which steel girders or heavy timbers are used. The bulletin contains a complete set of specifications and a list of users. A questionnaire is inserted in the bulletin for the use of prospective buyers.

INDUSTRIAL GLOVES.—Gloves and mittens for use in industrial plants are described and illustrated in a booklet being distributed by the Industrial Gloves Corp., Chicago. These gloves and mittens are long fiber chrome tanned leather and are sewed with steel thread. Parts of the glove which come in contact with wear are reinforced with small ribbons of steel, clinched through the leather, in such a way that they can not hurt the hand or come loose. Other data are given in the booklet.

MAGNESITE.—The Northwest Magnesite Co., Chewelah, Wash., has published an illustrated booklet containing information about the company's history, the manufacture of magnesite, its use. The first section of the booklet gives the history of the company. The second section describes the company plant and deposit and a third section is devoted to describing methods for microscopic examination, which is accompanied by a number of colored plates, illustrating magnified sections of magnesite brick.

CRANES.—Cranes adapted for machine shop or similar service are described in a 16-page illustrated booklet recently published by the Toledo Bridge & Crane Co., Toledo, O. In these cranes, the trolley sides are I-beam or box sections and constructed of semisteel or cast steel. The sides are joined by a builtup cross girt. The drums are gray iron and all gears are machined turned and cut from open-hearth steel castings. Other details are given and the illustrations give the reader a comprehensive idea of the crane.

GRINDERS.—An interesting booklet known as "The Operator's Handbook for the Blanchard High Power Vertical Surface Grinder," has been published by the Blanchard Machine Co., Cambridge, Mass. The booklet, which comprises 62 pages, offers information concerning grinders manufactured by the company, and contains instructions as to the care of these machines as well as operating details. The booklet has been prepared in a thorough way, and should be of particular interest to tool designers, machinists, etc., as well as production managers.

DERRICKS.—Derricks and locomotive cranes are described and illustrated in a 40-page booklet prepared by the Edward F. Terry Mfg. Co., New York. The derricks described include guy derricks, stiff-leg derricks, barge derricks and jinniwink derricks. Various parts of the derricks are also described and illustrated and complete specifications given. Hoisting engines, contractor locomotive cranes, and cranes designed for various other work, are also described and illustrated in the booklet. The last few pages of the book contain illustrations of actual crane and derrick installations.

HEAT TREATING FURNACES.—The McCann-Harrison Co., Cleveland, has published two circulars, in which two types of heat treating furnaces are described and illustrated. One folder is devoted to a description of a heavy underfired heat treating furnace. This furnace has a heavy cast iron and steel front, with steel plates and buckstays on sides and end. It is equipped with oil, gas or combination burners. The second folder describes a medium underfired heat treating furnace, which has a large combustion chamber and flue space under the hearth. The unit has a cast iron and steel front, with steel plates and buckstays on sides and can be equipped with oil, gas or combination burners. Line drawings of both furnaces are given.